DESIGN ANALYSIS REPORT
FOR THE
STA-1E CELLS 1-2 PSTA/SAV
FIELD-SCALE DEMONSTRATION PROJECT

PALM BEACH COUNTY, FLORIDA

Prepared for

US Army Corps
of Engineers®

JACKSONVILLE DISTRICT

CONTRACT NO. DACA-21-02-D-0004
DELIVERY ORDER CS03

SEPTEMBER 2005

SAIC®

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION (SAIC)

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

DESIGN ANALYSIS REPORT

for the

STA-1E CELLS 1-2 PSTA/SAV
Field-Scale Demonstration Project
Palm Beach County, Florida

SEPTEMBER 2005

Prepared for
U.S. Army Corps of Engineers
Jacksonville District

Prepared by
SAIC Engineering, Inc.
151 Lafayette Drive
Oak Ridge, Tennessee 37831

Paul Szerszen **Project Manager**	**Date**
Ronald Jones, Ph.D. **Lead Scientist**	**Date**
Bruce Haas, P.E. **Lead Engineer**	**Date**

CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK.

FIGURES

TABLES

ACRONYMS

cfs	cubic feet per second
DMSTA	Dynamic Model for Stormwater Treatment Areas
DOA	dry-out analysis
EAV	emergent aquatic vegetation
EDC	East Distribution Cell
ENR	Everglades Nutrient Removal Project
FAV	Floating Aquatic Vegetation
HRT	hydraulic retention time
IL-6	Interior Levee 6
msl	mean sea level
ppb	parts per billion
PSTA	periphyton stormwater treatment area
SAV	submerged aquatic vegetation
SFWMD	South Florida Water Management District
STA	stormwater treatment area
STADG	Stormwater Treatment Area Design Group
TP	total phosphorus
USACE	U.S. Army Corps of Engineers
WCA	Water Conservation Area
WS	water surface

THIS PAGE INTENTIONALLY LEFT BLANK.

1 GENERAL DESCRIPTION

1.1 PROJECT DESCRIPTION

The C-51/STA-1E Project is part of the Everglades Construction Project to treat urban/agricultural drainage and to provide additional water to the Everglades. As a macrophyte stormwater treatment area (STA), represented in **Figure 1**, its purpose is to treat the water so that total phosphorus in the discharge waters is 50 parts per billion (ppb) or less. Natural levels of total phosphorus (TP) within the waters of the Everglades are generally below 10 ppb. Traditional wetlands-based STA technology cannot remove enough phosphorus to achieve these natural levels. Thus, the C-51/STA-1E Project is designed to demonstrate an innovative treatment technology at a pilot scale to improve the water quality by reducing the total phosphorus concentrations in the discharge to levels approaching 10 ppb so that it may be diverted to Water Conservation Area (WCA) 1 in the Loxahatchee National Wildlife Refuge, located in Palm Beach County, Florida.

The U.S. Army Corps of Engineers (USACE), Jacksonville District, has been pilot testing a biotechnology known as periphyton stormwater treatment areas (PSTAs) to achieve a greater reduction in phosphorus. In these pilot tests, the hydrologic regimes are manipulated to create successive dry outs, which "activate" the periphyton by selecting a community of periphyton with superior water treatment capabilities.

The USACE Jacksonville District is planning to conduct a field demonstration of the PSTA technology within the existing footprint of STA-1E in what is known as Cell 2. Demonstration cells will evaluate three different alternatives for the development of activated PSTAs. The field demonstration, expected to be conducted over a 24-month operation period, will be used to determine the optimum design parameters, operational parameters, and recommendations for full-scale implementation of PSTAs for STA-1E.

The conceptual treatment train for the field-scale demonstration of PSTAs in STA-1E (Cells 1 and 2) will use emergent-growth wetland vegetation in Cell 1 and a submerged aquatic vegetation (SAV) area and cyanobacteria-dominated periphyton cells in Cell 2, as represented in **Figure 2**. A conceptual layout and a flow diagram of the emergent aquatic vegetation (EAV)/SAV/PSTA treatment train in Cells 1 and 2 are shown in **Figure 3**.

1.2 PURPOSE AND SCOPE

The purpose of this report is to present information on the conceptual design analyses, configurations, and operational requirements for the field-scale demonstration cells. The design of the PSTA cells, including plans and specifications for construction, will be completed by the USACE Jacksonville District, who will also prepare the construction cost estimate.

The overall project objective is to obtain TP removal to 10 ppb or less at the outflow of the PSTA cells in Cell 2. The objective of the demonstration cells is to demonstrate and evaluate up to three different substrates for the development of activated PSTAs. The project schedule is of critical importance to the USACE Jacksonville District due to ongoing activities in the area, commitments to the South Florida Water Management District (SFWMD), and the *Comprehensive Everglades Restoration Plan* schedule.

Schematic of STA-1 East (Not to Scale)

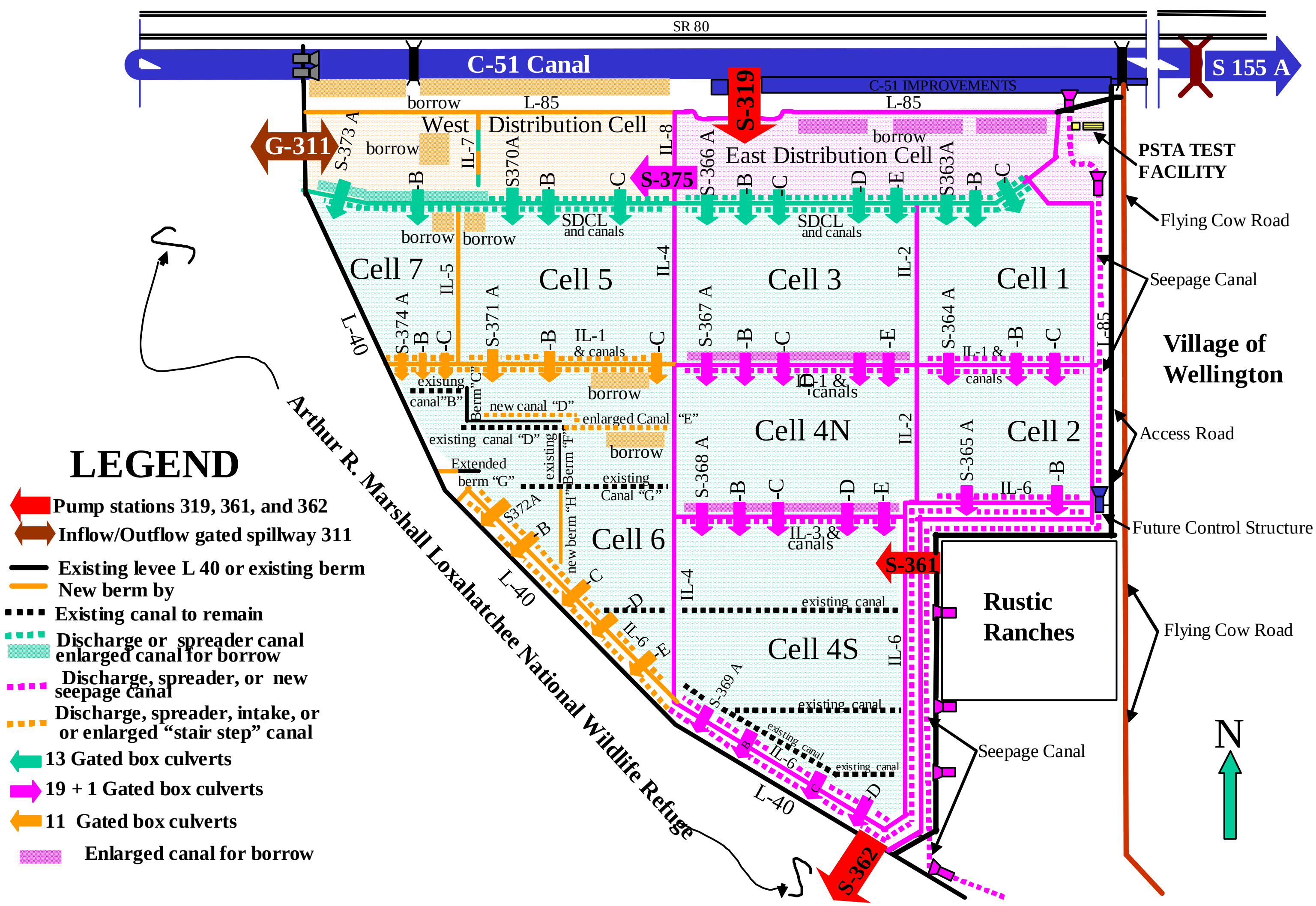


Figure 1. STA-1E Schematic Layout (USACE)

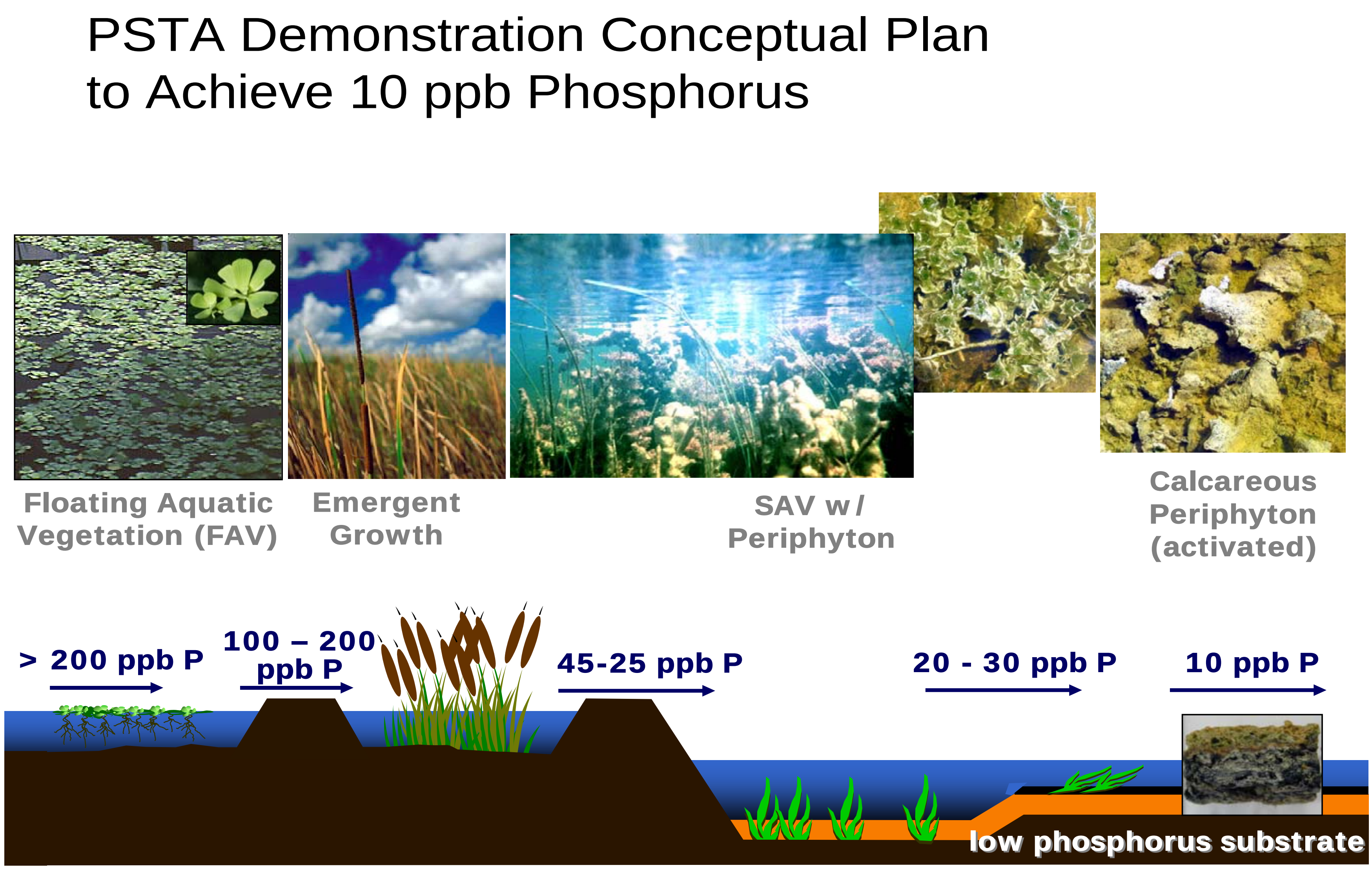


Figure 2. STA-1E Conceptual Treatment Train (USACE 2003)

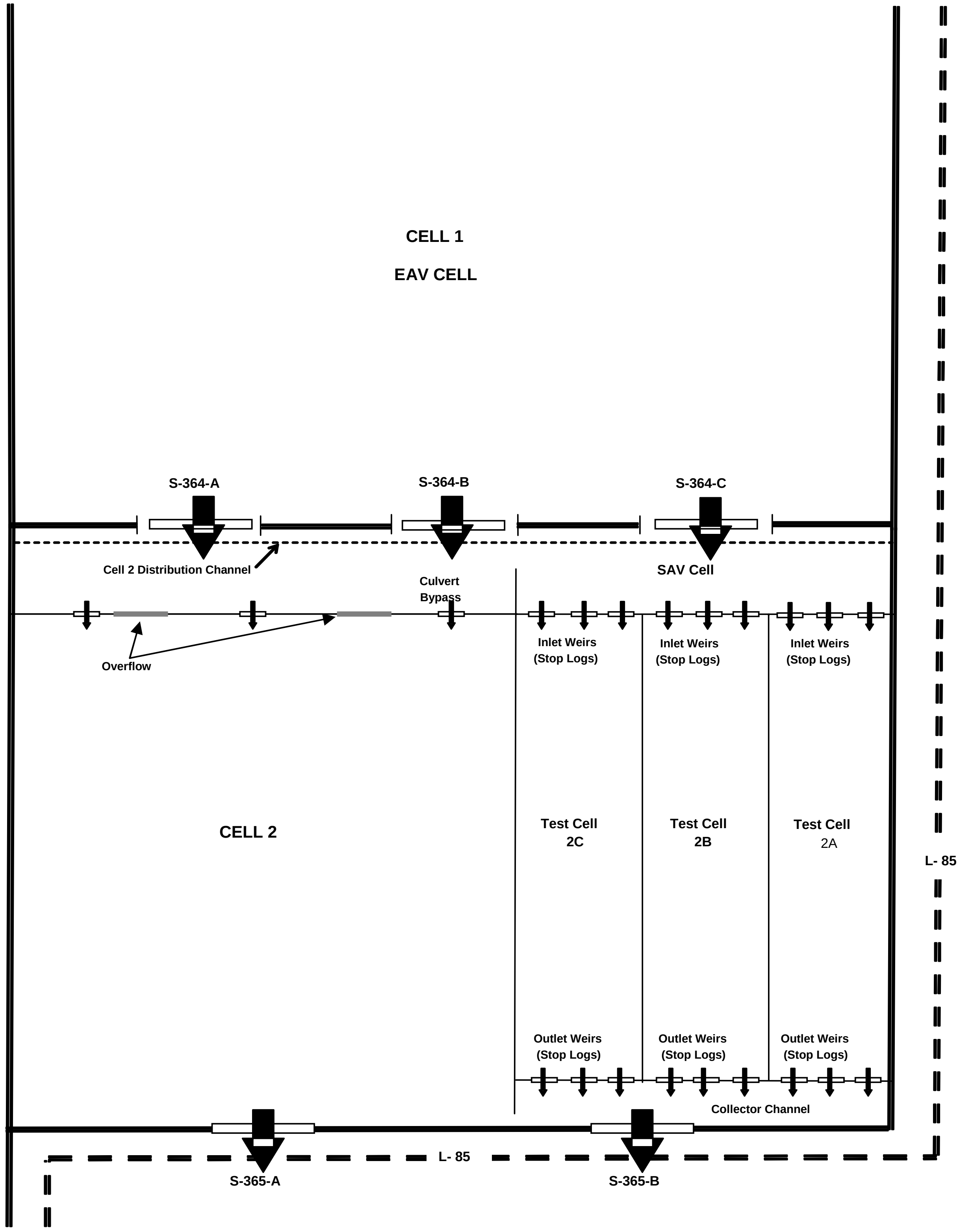


Figure 3. Flow Diagram for the C-51/STA-1E PSTA/SAV Field Demonstration Project (Cells 1 and 2). Not to Scale.

The scope of the design analysis includes documentation of the civil engineering, hydraulic engineering, and biological/environmental engineering provisions for design of the demonstration cells. **Table 1** summarizes the design analysis approach followed for the *Design Analysis Report* for development of the STA-1E PSTA/SAV Field-Scale Demonstration Project.

Table 1. PSTA Cell Design Analysis Approach for the *Design Analysis Report* for the STA-1E PSTA/SAV Field-Scale Demonstration Project

1. Establish the Cell Size
    a. Area – determine the length to fit inside the eastern levee of Cell 2; it will be the same for all three demonstration cells. Determine the width to proportionally distribute flow within Cell 2. Size the PSTA Cells to pass through them approximately 1/3rd of the Cell 2 flow.
    b. Flow range – establish the anticipated fluctuation of flow over time (10-year dry-out analysis).
    c. Depth range – establish the anticipated fluctuation of reservoir depth over time (10-year dry-out analysis).
    d. Hydraulic retention time range – establish the anticipated retention time fluctuation by analysis of flow range and depth range (10-year dry-out analysis).
    e. Frequency analysis – determine the frequency of exceedance of a given retention time.
2. Assure adequate water quality for PSTA cells inflow. For the *Design Analysis Report,* obtain currently available STA-1E monitoring data for the EDC and Cell 1 to gauge treatment achieved. If the monitoring data are unavailable or insufficient to determine treatment, use ENR buffer cell data, if appropriate, to project EDC treatment. Use the DMSTA model to project expected Cell 1 treatment. Provide SAV treatment in Cell 1 or 2 to achieve 30-50 pbb for PSTA cells inflow.
3. Establish the Cell Elevation Profile
    a. Existing ground surface – determine the average planar surface across the three demonstration cells based on existing survey data and cut-and-fill balance with +/- 0.125 ft tolerance.
    b. Demonstration cell bottom surface – determine the finish grade based on 0.5 ft fill placed on top of the existing ground surface plane.
    c. Maximum water surface – determine the maximum flow and maximum elevation of the water surface within Cell 2 during the 10-year dry-out analysis.
    d. Levee elevation – determine the elevation of the top of the levees (berms) separating the three demonstration cells by using the maximum water surface.
4. Establish the Demonstration Cell Design Flow Range
    a. Depth range – provide for operation in 0.5 ft increments up to 2.75 ft.
    b. Hydraulic retention time range – provide for operation in a range from 4 to 21 days.
5. Establish Hydraulic Controls for Each Flow Scenario
    a. Head drop – establish the rating curves for stop-log gates.

1.3 REPORT ORGANIZATION

This report was prepared in accordance with *USACE Engineering Regulation ER1110-345-700*. It consists of two chapters and associated appendices. Chapter 1.0 describes the project background and summarizes the purpose and scope of this design analysis. Chapter 2.0 presents the civil engineering, hydraulic engineering, water quality engineering and biological/environmental engineering provisions for design of the demonstration cells. Appendix A includes the simulated period of record analysis. Appendix B includes hydraulic and seepage calculations; Appendix C includes Dynamic Model for Stormwater Treatment Areas (DMSTA) modeling information; Appendix D includes responses to comments provided by the Stormwater Treatment Area Design Group (STADG); Appendix E includes the rationale for utilization of floating aquatic vegetation (FAV) in STA-1E; and Appendix F includes preliminary design drawings.

2 DESIGN REQUIREMENTS AND PROVISIONS

2.1 CIVIL DESIGN REQUIREMENTS

- **Demonstration Cell Layout:** The demonstration cells have been configured to maintain the same rectangular shape (length and width) for all three demonstration cells. The demonstration cells are located against the existing eastern embankment of Cell 2, levee L-85. The maximum length available along the eastern embankment of Cell 2 is approximately 4,500 ft. The area of each demonstration cell was established by considering Cell 1 and 2 constraints and equal flow distribution in Cell 2. The PSTA cells are preceded by a SAV cell. The SAV cell is laid out to allow flow starting at inflow structure S-364 A at the northwestern end of Cell 2 to the PSTA cell inflows at the northeastern side of Cell 2.

- **Demonstration Cell Elevations:** The bottom elevation of each demonstration cell was established by the USACE Jacksonville District based upon the existing check surveys within Cell 2. The average planar surface across the three demonstration cells was determined based on this existing survey information and by establishing the design subgrade elevation as an approximate "best fit" cut-and-fill balance with a 3 in. tolerance. Therefore, the subgrade will be allowed to vary +/- 0.125 ft from the design planar surface. This will optimize earthmoving and site preparation costs while controlling water depths across each cell to within a 3 in. tolerance so that the effect of water depth (varying from 0.5 to 2.75 ft) on PSTA treatment effectiveness can be tested.

  The demonstration cell finish-grade elevation was established by adding 0.5 ft to the subgrade elevation planar surface. Each substrate alternative will add 0.5 ft of material to the subgrade so that all three demonstration cells operate at the same water depth. This will maintain consistent demonstration conditions across the three demonstration cells. Cell elevation detail is shown in the preliminary design drawings in Appendix E.

  Ten-year dry-out analysis (DOA) (water year 1979 through water year 1988), developed by Burns & McDonnell (**Burns & McDonnell 2000**) and provided by the USACE Jacksonville District, was used to estimate the 10-year period of record stipulated in the Settlement Agreement. The estimated POR was then used to determine the maximum anticipated depth with the STA-1E. A maximum depth of 2.63 was predicted by the DOA. Therefore, a maximum demonstration depth of 2.75 ft of water was chosen for establishing perimeter levee elevations. Because the demonstration cells are temporary structures with a design life of less than 3 years, minimum freeboard was provided above the maximum depth of water. Because the top of the substrate elevation is 16.25 ft, NGVD29, the internal levee elevations were therefore set at a minimum of 19.50 ft, NGVD29.

- **Levee Configuration:** The internal levees have been configured to provide a 12 ft top width, which will provide sufficient space for construction haul vehicles and levee maintenance vehicles. Levee side slopes have been set at 3H:1V to optimize tradeoffs between minimum cost and minimum slope sloughing considerations. The levees are to be constructed of native silty and sandy soil material from

Cell 2 to limit seepage through the levees. Six in. of limestone/cemented sandstone provided from an existing on site stockpile alongside Internal Levee 6 (IL-6) will be placed on top of the levees to allow for easier access during wet weather and to limit erosion.

- **PSTA Cell Access Features:** Access ramps will be provided on the southwest side of each PSTA demonstration cell and the western side of the SAV cell to allow access to demonstration cell interiors for monitoring, maintenance, and operations. Additionally, sufficient space will be provided at each levee intersection to allow maintenance vehicles to turn around. At this time, these features are not shown in the preliminary design drawings in Appendix F.

- **Substrate Material:** The three demonstration cells are to be constructed using three alternative sources and types of substrate material. The following three substrates have been selected based on an evaluation of material costs, availability, lime content, and treatment effectiveness (**SAIC 2005**). Additionally, an evaluation of Cell 2 prior to construction is required to determine if vegetation clearing is needed prior to substrate installation.

  Limestone/cemented sandstone (6-inch depth) provided from an existing on site stockpile alongside IL-6 within Cell 4S.

  Limestone/cemented sandstone (4-inch depth) provided from an existing on site stockpile (IL-6) covered with imported Fort Thompson Formation limestone (2-inch depth) provided from an existing limestone supplier. The substrate depth in this cell will optimize the use of the more costly imported Fort Thompson limestone while maintaining a sufficient thickness of limestone above the native soil.

  Native silica sand borrowed from Cell 2 covered with imported lime sludge (average 1-inch depth) provided from an existing Palm Beach/Broward County supplier.

  Laboratory analyses of cell substrates, identified sources, and requirements for material yet to be acquired are shown in **Table 2**. Information on unexcavated on site material is provided due to its potential use for full-scale application if the material stockpiled on site performs successfully at the demonstration scale. These materials are quite similar with the exception of the stockpiled material, which contains the Riviera Sand overburden. The source of the unexcavated on site material data is the analysis of a compilation of samples taken from a core drilled near S-361.

Table 2. Projected Substrate Characteristics

Material Type	Material Location	Calcium Carbonate (%)	Total Phosphorus (ppm)
Lime sludge	Broward County	65.7	109.4
Lime sludge	Palm Beach County	77.7	81.9
Limestone	Stockpiled on site (IL-6)	30-95	<75
Limestone	Unexcavated on site	53.8	41.9
Limestone*	Fort Thompson Formation	>75	<100

* Fort Thompson Formation limestone should not contain overburden and should be limited to <2.5% organic material.

- **Monitoring and Operational Features:** Flow control structures have been provided at the inlet and outlet to each demonstration cell to allow manual control of water depths and flow rates through each demonstration cell. The conceptual design does not include remote control of water depth or flow rate. Manual control is provided through use of stop-log gates. Hydraulic design of the stop-log gates is discussed in Section 2.2. Three flow control structures will be provided to provide sufficient capacity to control flow into and out of each demonstration cell for the range of depths and flows required for testing.

  A culvert has been provided at each inlet and outlet flow control structure to convey water through the levee while allowing vehicle access around each demonstration cell for maintenance and monitoring. Each culvert has been designed for a maximum 10-year DOA flow rate of 95 cubic feet per second (cfs). The stop-log gates will control the demonstration cell operational flow rates. Additional culverts will be installed on the southern levee of the SAV cell to allow for water in this cell to be directed to the Cell 2 PSTA cell bypass. The dimensions and placement locations of these structures are shown in the preliminary design drawings in Appendix F.

  Stilling well monitoring points will be established at the northern and southern ends of each demonstration cell and the SAV cell to measure differences in operational head at the inlet and outlet to each cell. Each stilling well will consist of 4 in. diameter polyvinyl chloride pipe extending vertically through the depth of the levee, with 2 in. diameter polyvinyl chloride pipe extending horizontally to the adjacent distribution channel. The 2 in. diameter horizontal extension will rest 6 in. above the bottom of the collection channel. The stilling wells will provide housing for stage recorders.

  Other Critical Design Features: An internal structure upstream of the outlet control structure of each cell was designed to retain the periphyton and to prevent their migration out of the demonstration cell. This structure will consist of a floating boom or equivalent.

  Spreader channels have been provided after the inlet control structures, about one-third and two-thirds of the way into each cell, and prior to the outlet control structures in each demonstration cell to minimize the occurrence of concentrated flow areas. The spreader channels were sized based on the minimal cross-sectional area required to dissipate the maximum flows anticipated. The spreader channels will have 3H:1V side slopes and a 5 ft bottom width. The possible installation of additional spreader channels will be considered as the budget allows.

2.2 HYDRAULIC DESIGN REQUIREMENTS

Hydraulic design requirements have been developed through analysis of the anticipated flow, depth, retention time, and their frequencies of occurrence within the 10-year DOA developed by Burns and McDonnell (**Burns & McDonnell 2000**). The data utilized was from January 1, 1979, to December 31, 1988. The Burns & McDonnell modeling goal was to simulate the “dry out” case, i.e., operations to support retaining a minimum 0.5 ft water depth and a maximum varying from 1 to 2 ft. The inflow to STA-1E was in response to the hydrologic conditions during the time period modeled. Subsequent internal flow distribution was controlled through gate and weir settings required to maintain the minimum and maximum depths. The details of DOA analysis for POR are presented in Appendix A.

The DOA was analyzed for the hydraulic retention times (HRT) simulated for Cell 2. **Figure 4** is a representation of the HRT in Cell 2 during the DOA POR. Seven-day averaging was utilized. A cell depth of 2.75 ft was used in the calculation for HRT to better reflect HRTs during high-flow conditions. The HRT should be higher than presented for high-flow periods due to flow attenuation and the increased depth/storage in the cells that is discharged over periods following excess rainfall events. This figure demonstrates there are no days in 10 years where HRT is 3 days or less; there are 4 days when HRT is from 3 to 4 days; and there are 20 days when HRT is from 4 to 5 days. **Table 3** summarizes the HRTs, depths, and the proportional velocities occurring in each of the PSTA cells.

Table 3. Range of Test Cell Flow Rates (all values in cfs)

		Average Hydraulic Retention Time (days)			
		3.5	**7**	**14**	**21**
Average Depth of Flow (ft)	**0.5**	3.35	1.68	0.84	0.56
	1.0	6.71	3.35	1.68	1.12
	1.5	10.06	5.03	2.51	1.68
	2.0	13.41	6.71	3.35	2.24
	2.5	16.77	8.38	4.19	2.79
	2.75	18.44	9.22	4.61	3.07

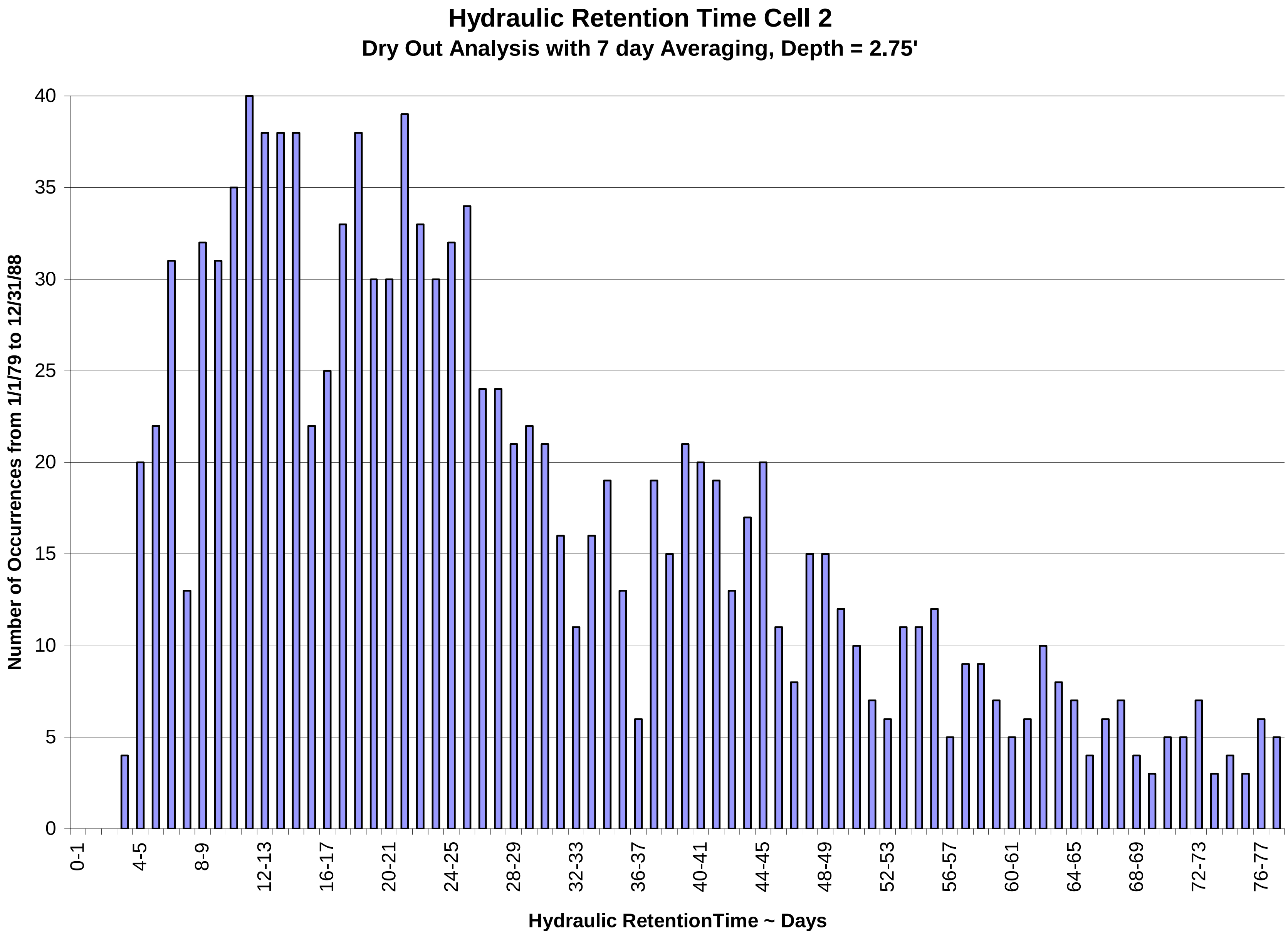


Figure 4. Hydraulic Retention Time for Cell 2

- **Maximum Water Surface**: For the DOA, the maximum water surface elevations in the distribution channel of Cell 2 was 17.59 ft. The average water surface elevation in Cells was 16.39 ft. The flow in and out of the cell was assumed to be the 10-year DOA peak flow (855 and 860 cfs). The flows through the stop-log and culvert both upstream and downstream were assumed under submerged weir conditions.

- **Seepage:** The seepage (crosstalk) between adjacent demonstration cells through levees has not been calculated, as the hydraulic conductivity numbers for Cell 2 PSTA cells' levee material are not available at this time. Once they are available, this information will be provided. Crosstalk calculation for internal levees will be performed for the worst-case scenario where one cell is dry while its neighboring cell is filled to the maximum selected demonstration depth of 2.75 ft. The seepage will be assessed using Darcy's law as follows:

$$q = \left(K \frac{H}{W} \right) \left(HL \right) \tag{2}$$

  where q = seepage flux, K = hydraulic conductivity, H = maximum head difference (2.75 ft), W = flow length, and L = length of demonstration cell.

  The seepage through the Surficial Aquifer beneath STA-1E into the PSTA cells from the adjacent portion of Cell 2 cells was estimated as shown in Appendix B. Based on a Surficial Aquifer thickness of 120 ft and hydraulic conductivity of 40 ft/day, seepage was estimated to range from 12 to 27 cf/day per foot of head per foot of levee. A value of 15 cf/day was chosen to reflect the presence of the highly permeable Floridan Aquifer underlying the site. Under a maximum head difference of 1.35 ft between the PSTA test cell and the adjacent portion of Cell 2 and a PSTA perimeter levee length of 3,900 ft, the seepage into the PSTA test cells was estimated to be less than 1 cfs. Under a maximum head difference of 7.0 ft between the PSTA test cell and this adjacent seepage canal, the seepage out of the PSTA test cells was estimated to be less than 5 cfs. The specific operating scenarios and associated seepage will be further addressed in the Operations Plan.

- **Head Loss through Cell**: The hydraulic head loss through a PSTA demonstration cell was estimated as shown in Appendix B.2. Based on 3,900 ft long by 520 ft wide cell dimensions, a maximum test flow of 18.44 cfs, and a maximum test flow depth of 2.75 ft, head loss was calculated for a range of Manning's coefficients. For relatively smooth to moderately vegetated surfaces having a Manning's coefficient less than 0.3, these calculations result in hydraulic head loss less than 0.01 ft. For densely vegetated surfaces (e.g., sawgrass), these calculations would predict a head loss of less than 0.2 ft.

- **Flow over Stop-Log Weir**: The flow through one of the inlet or outlet control structures at a PSTA demonstration cell was estimated, as shown in Appendix B.3, for various heights of water above the stop-log weir. This represents a "rating curve" for the control structures. For a maximum flow of 18.44 cfs through a demonstration cell (6.15 cfs through one control structure), the depth of flow over the stop-log weir is estimated at 0.7 ft.

- **Head Loss through Inlet Structure**: The total hydraulic head loss through one of the inlet control structures was estimated as shown in Appendix B.4. These calculations account for a maximum test flow depth of 2.75 ft within the PSTA demonstration cell, friction losses, 1.0 ft of board clearance to avoid submerged weir conditions, and 0.7 ft flow depth over the stop-log weir. These calculations show that under maximum test flow conditions, a water surface elevation of 20.874 ft would need to be maintained within the SAV cell upstream of the PSTA demonstration cells.

2.3 WATER QUALITY DESIGN REQUIREMENTS

The DMSTA model was utilized to analyze numerous combinations of biological treatment trains upstream of the PSTA demonstration cells to determine the level of pretreatment they will provide. Because the treatment efficiencies of the distribution cell are unknown for this application of the DMSTA, the highest TP into the STA was chosen as the defining condition. This TP value is documented as 214 ppb. The inflow concentration to the PSTA demonstration cells is targeted to be 30 ppb, hence this number was chose as the target for the PSTA cells' pretreatment. A short-term upper limit of 50 ppb was also tracked, but since PSTA may not be sustainable at this higher level without extensive maintenance, the 50 ppb should be used only for illustrative purposes. The PSTA cells will be tested to demonstrate reductions in TP from 30 to 10 or below for TP out. Each of the three PSTA demonstration cells; requires approximately 18.44 cfs (55.32 cfs total) plus seepage losses to be tested through the full range of established test conditions.

Figure 5 illustrates the output from the DMSTA model for two configurations:

1. Cell 1 containing 515 acres of effective EAV. EAV is the least management intensive type of aquatic vegetation but has the lowest settling rate. This passive treatment functions with little management but requires large land areas. EAV can effectively reduce TP to a limit of about 30 ppb. The upper curve in **Figure 5** represents this modeled configuration. At a required inflow of 55.32 cfs, the results indicate the inflow TP concentration into the PSTA cells is 79 ppb. This configuration thus fails to meet the required inflow concentration of 30 ppb for all three test cells.
2. Cell 1 containing 515 acres of effective EAV plus 50 acres of effective SAV in Cell 2. SAV is effective in reducing TP down to about 15 to 20 ppb, as periphyton will grow as part of this community. SAV has a much higher settling rate but may prove to be more management intensive and is much more susceptible to dry-out damage. SAV may require supplemental water in drought conditions to survive. The lower curve in Figure 5 indicates the further reduction achieved by the 50-acre SAV. At a required inflow of 55.32 cfs, the results indicate that the inflow TP concentration into the PSTA Cells is 61 ppb for all three test cells. This configuration also fails to meet the required inflow concentration of 30 ppb for all three PSTA demonstration cells. However, one PSTA demonstration cell could be tested through the whole range of hydrologic and phosphorus concentration requirements utilizing this configuration.

Figure 6 depicts an overview of the physical modifications of the treatment train needed to obtain the desired phosphorus concentrations entering the demonstration cells. It includes a 70-acre floating aquatic vegetation (FAV) cell in the East Distribution Cell (EDC). **Figure 7** illustrates the output from the DMSTA model for the same configuration as described above, with the 70-acre effective area of FAV upstream of Cell 1 in the EDC. FAV is very effective at removal of TP from high concentrations down to about 50 ppb. Its performance and potential usefulness for the performance of the STA-1E overall are described in **Appendix E**. FAV settling rates are similar to SAV. The aforementioned limits of 50 ppb for FAV and 30 ppb for EAV are built into the Figure 7 model results to more properly depict the limits of their respective treatment abilities. The required treatment areas were defined by the 55.32 cfs condition and the 214 ppb TP inflow concentration. The DMSTA model was utilized to establish that a 70-acre effective FAV area had to be added to the 515-acre EAV and 50-acre SAV to meet the required test conditions of 55.32 cfs, 214 ppb TP Cell 1 inflow, and the 30 ppb TP concentration inflow to the

PSTA demonstration cells. Results for all other lower flow conditions are below the required 30 ppb into the PSTA demonstration cells. This configuration thus successfully meets the required inflow concentration of 30 ppb for all three PSTA demonstration cells.

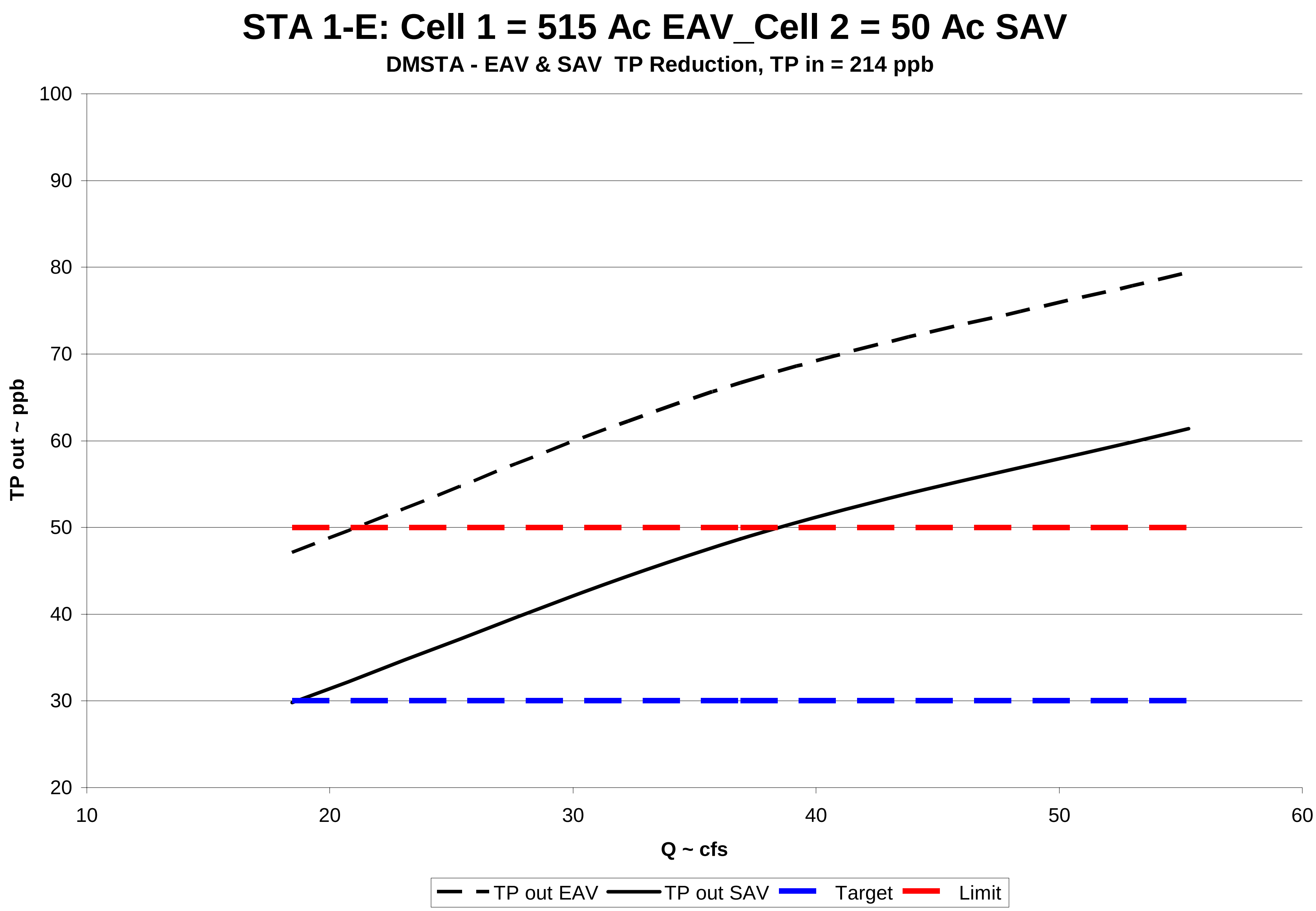


Figure 5. Phosphorus Removal prior to Demonstration Cells with Baseline Condition and Addition of SAV

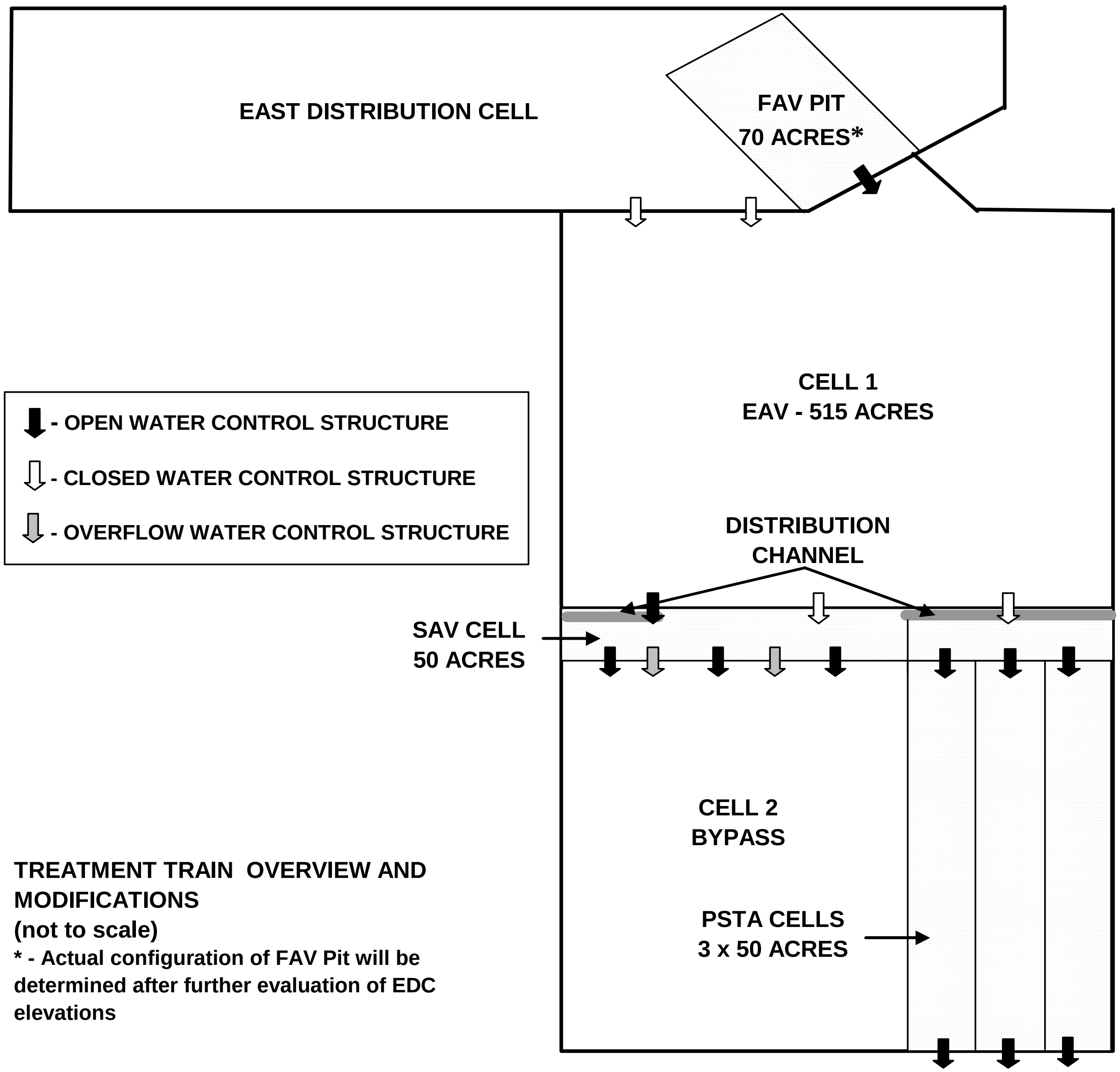


Figure 6. Treatment Train Modifications

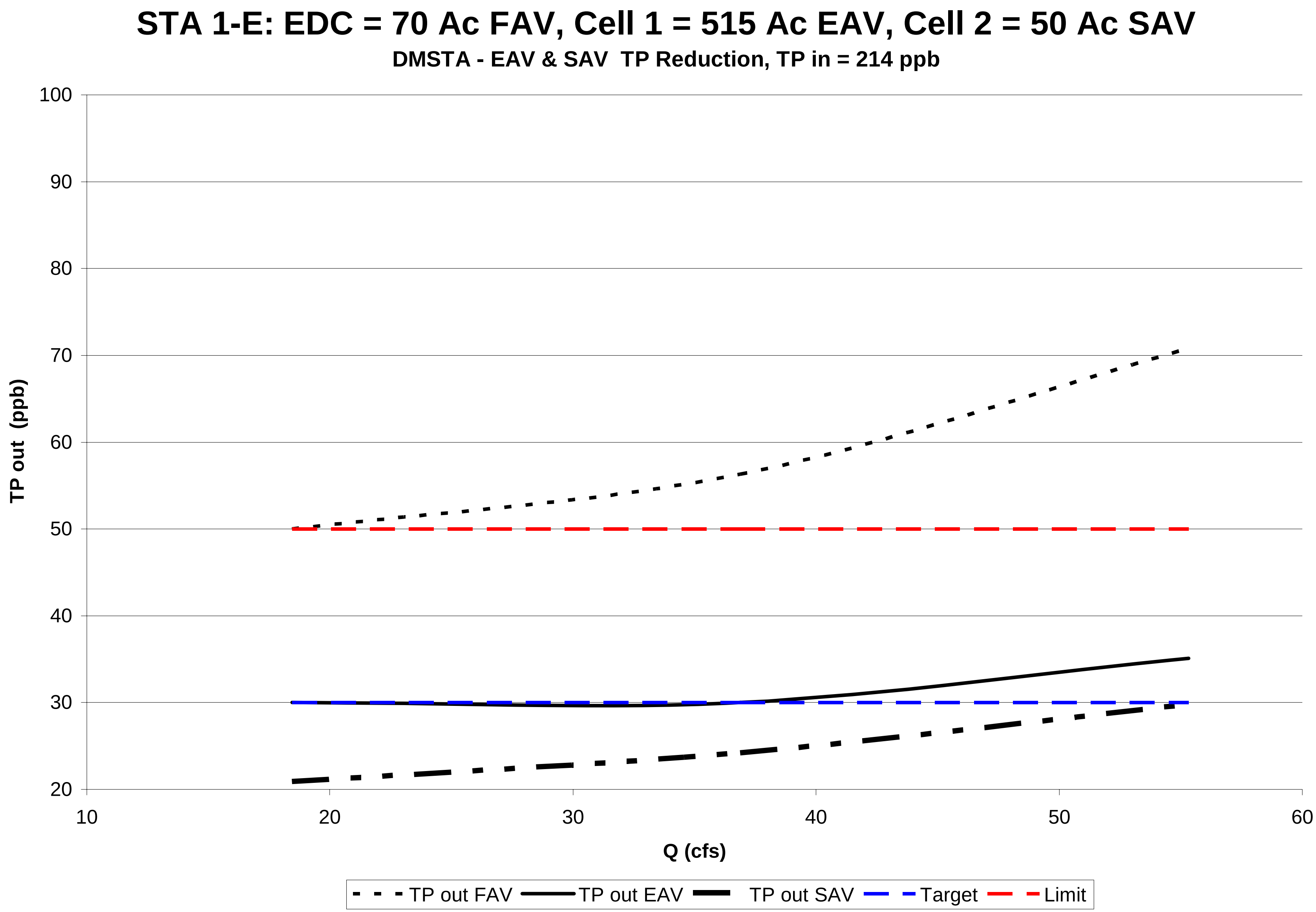


Figure 7. Phosphorus Removal prior to Demonstration Cells with addition of FAV and SAV

2.4 ENVIRONMENTAL DESIGN REQUIREMENTS

Environmental design requirements for the PSTA cells for the *Design Analysis Report* were established by consideration of periphyton biological requirements, monitoring requirements, and the theoretical system mass balance.

2.4.1 Periphyton Biological Requirements

The following biological requirements were established to create conditions for producing a calcareous periphyton community that, if properly operated, will deliver a 10 ppb phosphorous concentration at the treatment cell outlet control structures.

- **Water Quality:** The water entering PSTA demonstration cells should have a total phosphorus concentration less than 30 ppb.

- **Hydrologic Requirements:** The design of the PSTA demonstration cells and adjacent cell operation should allow for (1) complete drydown, (2) a ponding depth of 2 ft to eliminate non wetland vegetation during startup, and (3) a ponding depth of 0.5 ft, facilitating periphyton activation.

- **Added Substrate Requirements:** Substrate applied to native soil should be predominantly calcium carbonate. When substrate is limestone, it should be sized at 3 in. or less (ungraded material, with the largest-diameter material being 3 in., including the smaller-diameter material generated during processing). Limestone should have a phosphorus concentration of less than 100 ppm (ideally less than 75 ppm). Substrate should be of sufficient thickness to limit phosphorus reflux from native soils and to limit phosphorus mining by the rooted vegetation (both SAV and emergent). Added substrate thickness is dependant on the native soil type (sand or peat), the amount of labile phosphorus in the native soil, and the total phosphorus concentration in the underlying groundwater.

2.4.2 Monitoring Well Requirements

Groundwater monitoring wells are needed to make measurements for mass balance analysis. The specific determination of the number and placement of the wells can be made only as part of the comprehensive monitoring planning and, therefore, will be described in the PSTA facility Monitoring Plan. Well installation will take place at the same time as installation of other monitoring equipment, which will be at the beginning of the monitoring and operations phase of the PSTA/SAV field-scale facility.

2.4.3 Theoretical System Mass Balance

One of the major objectives during operation and monitoring of the PSTA field-scale facility is to understand the fate of phosphorus within the system. The two main aspects of understanding how phosphorus travels through the system are (1) measuring movement of water into and out of the cells and (2) measuring changes in phosphorus concentrations of the different components. Quantifying water inputs and outputs allows phosphorus concentration data to be extrapolated across the entire system.

Figure 8 provides a theoretical view of the inputs and outputs of water to the demonstration cells. During operation of the system, these flows will be monitored to the degree practicable. The following items could be inputs to the PSTA system: SAV cell water deliveries, rainfall, and seepage from adjacent cells and groundwater. The following items could be outputs from the system: demonstration cell effluent, evaporation, and seepage to adjacent cells and groundwater. Seepage is included as both an output and input, as it may change due to operations within the demonstration cells and the surrounding STA. This item will be the most difficult to quantify.

During field-scale facility operation, phosphorous measurements will be made to track its fate and the overall system performance. The process of determining the mass balance of the demonstration cells will include determining the phosphorus content of (1) water delivered from the SAV cell, (2) water intentionally discharged from the demonstration cells, (3) periphyton mats, (4) mat remnants (marl soils), (5) demonstration-cell-installed substrates (i.e., limesludge/sand and limestone), (6) precipitation, and (7) to the degree practicable, horizontal and vertical seepage. **Figures 9** and **10** show the phosphorous removal process and a theoretical mass balance flow diagram, respectively. The process shown in **Figure 9** describes how calcareous periphyton mats remove phosphorus from the water column and, ultimately, sequester it within marl soils. As part of the process, the cyanobacteria within the periphyton metabolize phosphorous within the water column to form alkaline phosphatase, which increases the biomass of the periphyton. An additional mechanism by which phosphorus is removed from the water due to the presence of periphyton is the assimilation of carbon dioxide from the water during photosynthesis, creating an alkaline environment within the periphyton mat. This elevated pH environment allows for the chemical removal of phosphorus by precipitation when excess dissolved organic carbon and nucleation sites are available. A schematic representation shown in **Figure 10** describes the phosphorous fate during its removal from water.

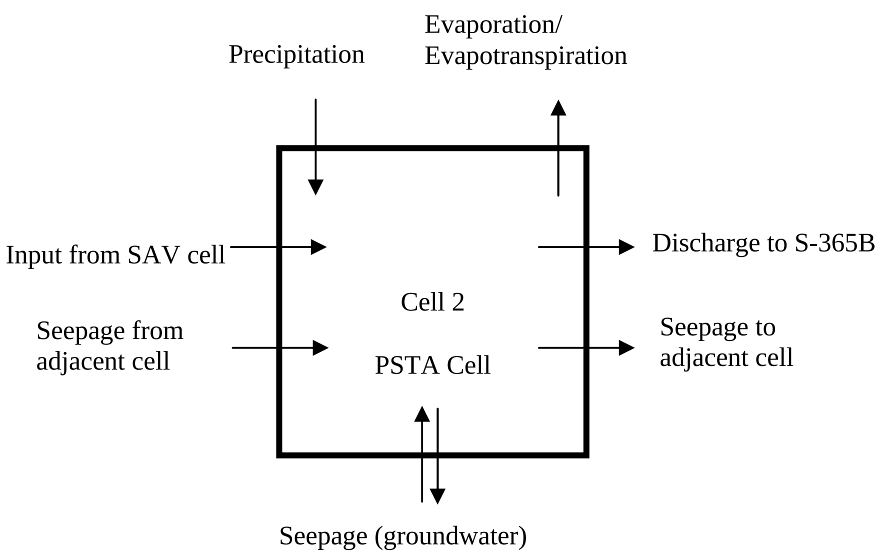


Figure 8. Schematic Representation of Water Balance

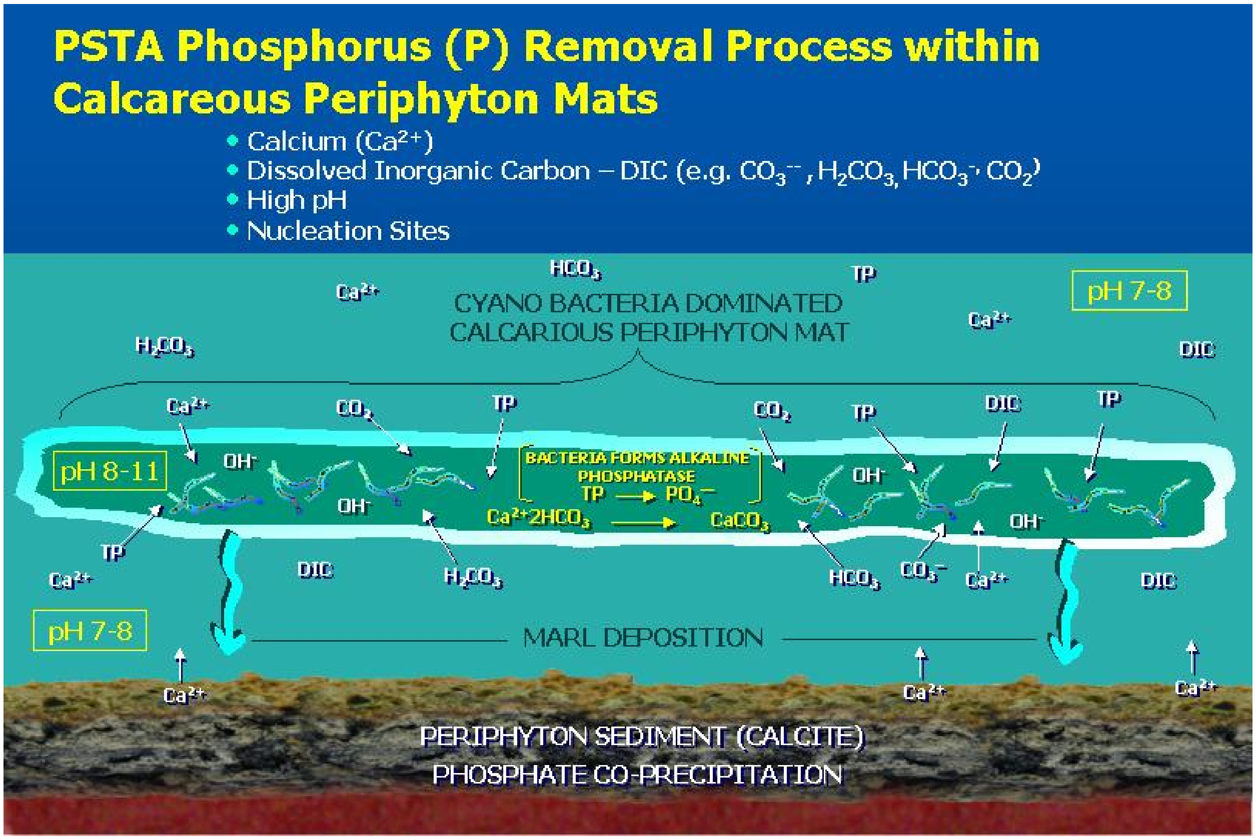


Figure 9. Phosphorus Removal Process within Calcareous Periphyton Mats (USACE 2003)

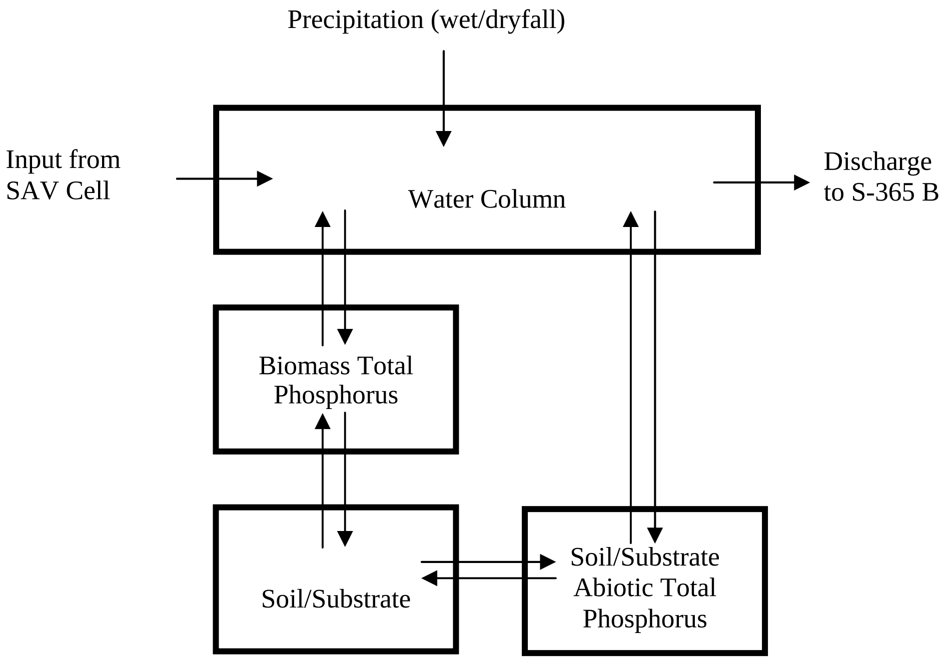


Figure 10. Schematic Phosphorus Mass Balance Flow Diagram for PSTA Demonstration Cells

3 REFERENCES

Burns & McDonnell 2000. *Stormwater Treatment Area No. 1 East Period of Record Dry-Out Analysis*, U.S. Army Corps of Engineers, Jacksonville District, 99-822-1-001, March.

Cedergren, H.R., *Seepage, Drainage, and Flow Nets*. 1967: Wiley, New York.

USACE (U.S. Army Corps of Engineers) 2003. *STA-1E (PSTA/SAV) Advanced Treatment Technology Implementation.*

Kadlec, R.H., and W.W. Walker 2003. *Technology Review of Periphyton Stormwater Treatment*, Draft Report, August.

SAIC (Science Applications International Corporation) 2005. *PSTA-Grade Limestone and Lime Sludge Availability for Use at STA-1E*, U.S. Army Corps of Engineers, Jacksonville District, March 8.

SFWMD (South Florida Water Management District) 1989. *Ground Water Resource Assessment of Eastern Palm Beach County, Florida Part II Plates and Oversized Appendices.* Technical Publication 89-4, December.

USACE (U.S. Army Corps of Engineers) 2000. *Periphyton Storm Water Treatment Area (PSTA), STA-1E Test Project, West Palm Beach County, Florida*, January.

APPENDIX A
DOA ANALYSIS FOR POR

The DOE analysis for POR yielded the following results:

- **Flow Range (10-year record):** The anticipated range of daily flows for Cell 2 was analyzed for the stipulated 10-year DOA. These flow range data are summarized in **Figures A-1** and **A-2**, which show the distribution of flow (in cfs) over time for the DOA. These data will subsequently be used to establish frequency curves and to select test flow scenarios within each demonstration cell for demonstrating PSTA performance. Specific flows to be tested will be discussed in the Operations Plan. As previously mentioned, the DOA flows for Cells 4S and 6 were also analyzed to provide demonstration scenarios representative of other STA-1E areas expected to be used for full-scale PSTA implementation.

- **Figure A-1** shows the STA-1E inflow. This is the pump station response to the hydrologic conditions and the DOA during the period of record. This inflow is through the pump station and does not include rainfall. The maximum rate is 3,980 cfs, the rating of Pump Station S-319. The typical wet and dry season patterns can be seen by viewing pumping rates. **Figure A-2** shows the number of days different pumping ranges occur. This figure illustrates that the pumps were not on for 539 of the 3,653 days of the DOA; the flow was from 0 to 180 cfs for 2,168 days of the DOA; the flow was from 180 to 360 cfs for 684 days of the DOA, etc. The figure shows that daily flow into the STA will be less than 1,000 cfs approximately 99% of the time.

- **Figure A-3** shows inflow into Cell 4S. Again, this is flow through the inflow structure for the DOA and does not include rainfall. The maximum daily flow is approximately 1,540 cfs. **Figure A-4** presents the same range distribution as discussed above for STA-1E. This figure illustrates that flow is less than approximately 600 cfs 99% of the time.

- **Figure A-5** illustrates Cell 2 outflow during the DOA. These data are plotted utilizing 7-day averaging, i.e., the outflow during that day plus that from the previous 6 days are averaged to emulate the flow attenuation that will occur with a gravity discharge structure. The anticipated discharge structure should simulate base flows with a bleeder, and discharges should increase with increasing storage in the cells. The DOA utilized a gated outflow structure that pulsed discharges. This calculation methodology resulted in flows up to about 260 cfs.

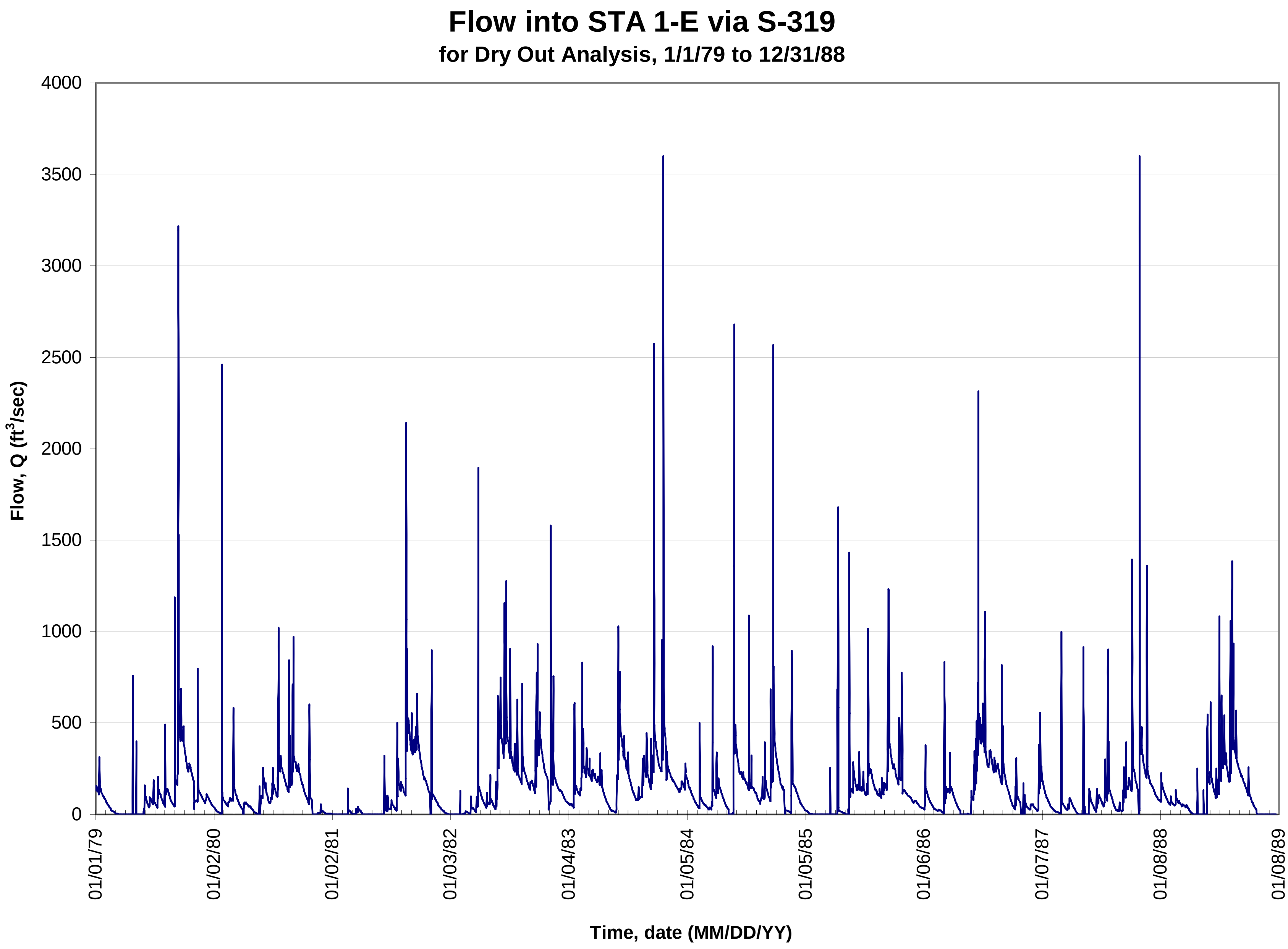


Figure A-1. Flow into STA-1E via S-319

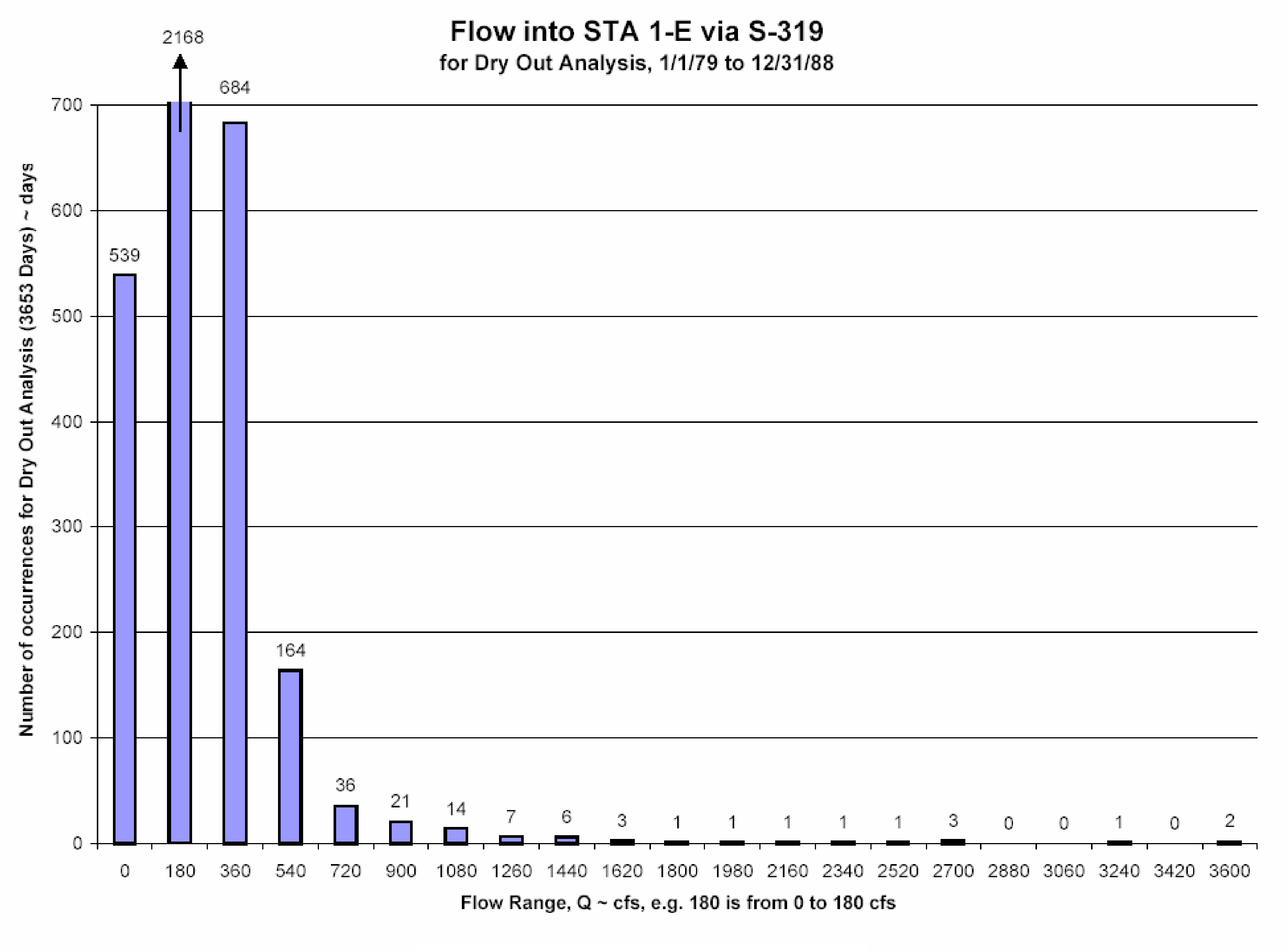


Figure A-2. Flow into STA-1E via S-319

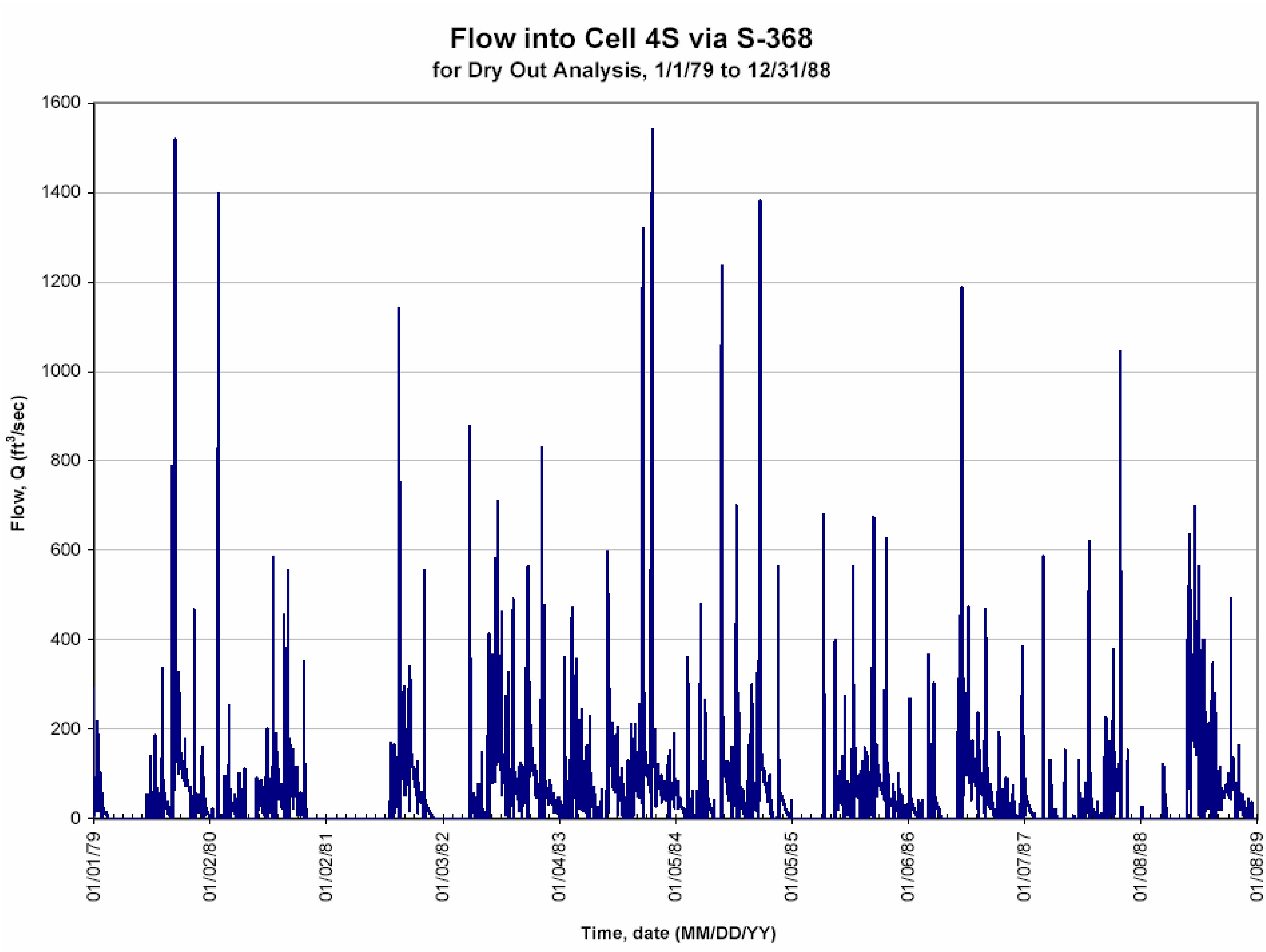


Figure A-3. Flow into Cell 4S via S-368

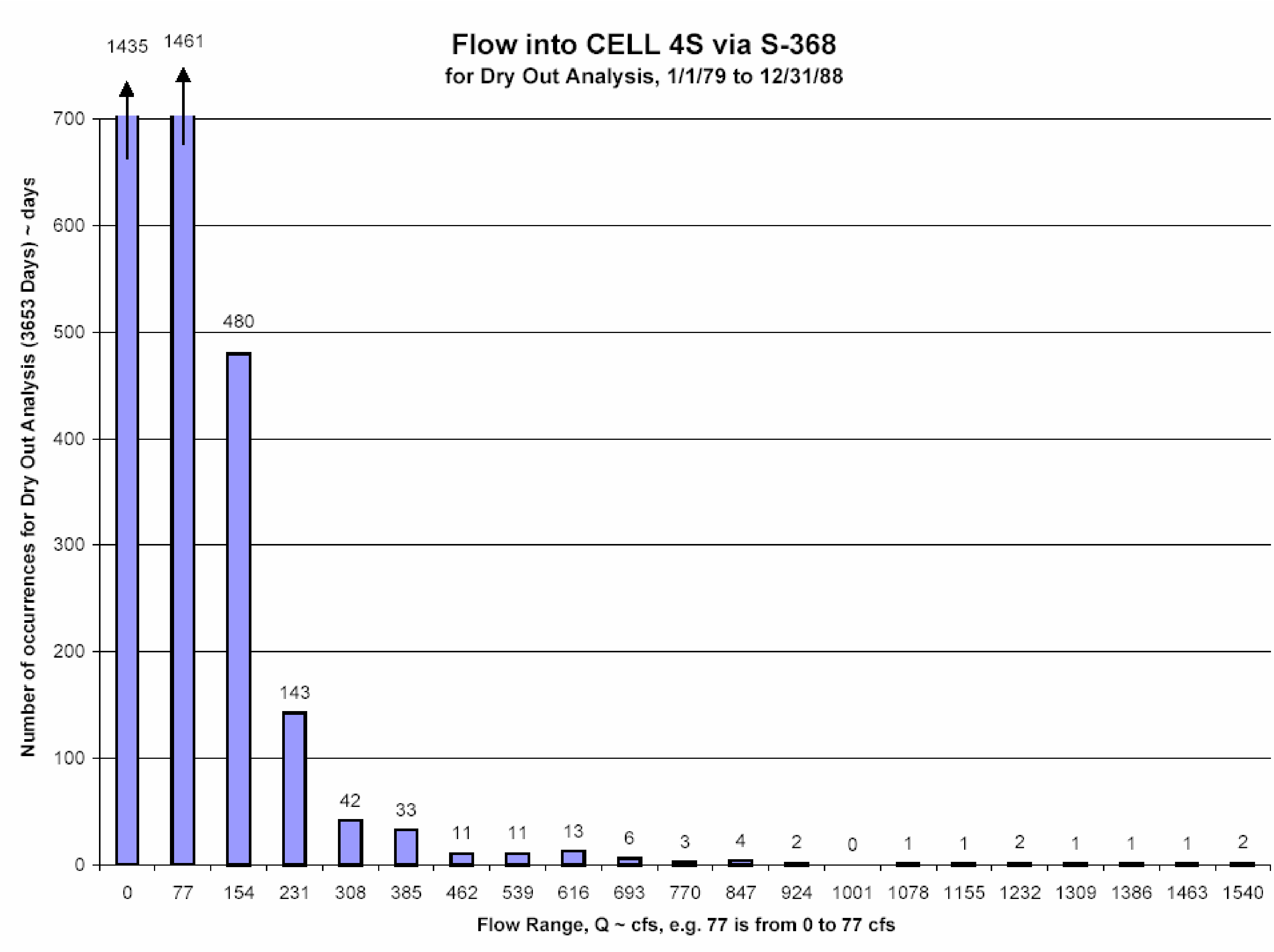


Figure A-4. Flow into Cell 4S via S-368

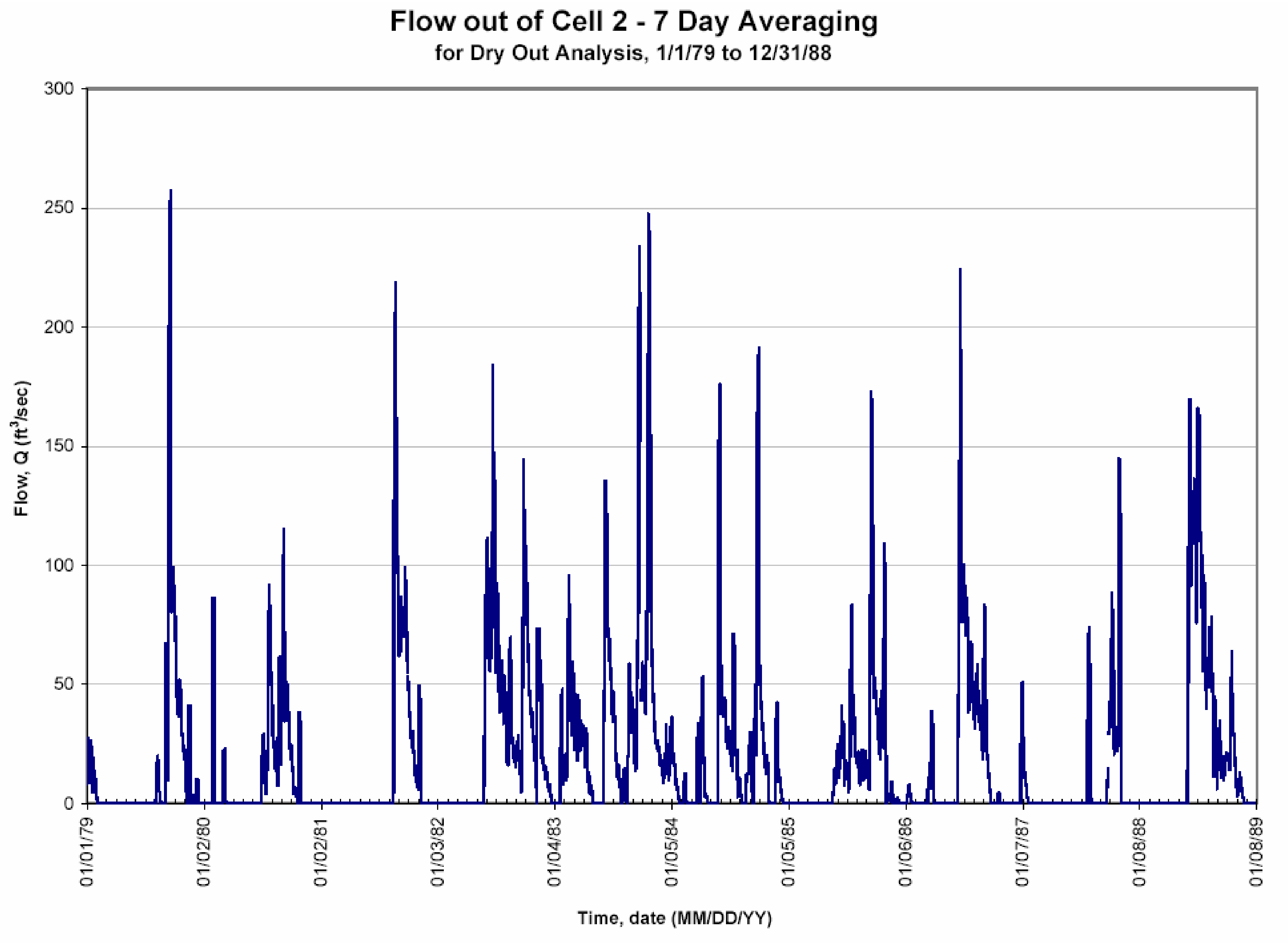


Figure A-5. Flow Out of Cell 2

APPENDIX B
HYDRAULIC AND SEEPAGE CALCULATIONS

APPENDIX B.1

Estimated Seepage through Surficial Aquifer from Adjacent Cells

PURPOSE:

Purpose of this calculation package is to estimate the seepage through the aquifer beneath STA-1E into the PSTA test cells from adjacent SAV cells.

Objective: Scenario 1: Surficial Aquifer overlies Floridan Aquifer: totally permeable base

Estimate the seepage per foot of head difference and per foot of levee length.

Assumptions:

1.	Surficial aquifer thickness	(b)	120	ft		Source: Table 2, TP 80-4, SFWMD
2.	Surficial Aquifer hydraulic conductivity	(k)	40	ft/dy		Source: Table 3, TP 80-4, SFWMD
	Seepage per foot of head per foot of levee	(q)				
	Length of levee	(L)	1	ft	(unit length)	
	Head difference	(h)	1	ft	(unit head difference)	
	No. of flow paths	(N_f)	5		(see flow net diagram)	
	No. of potentiometric drops	(N_p)	16		(see flow net diagram)	

q = $k * N_f/N_p * h * L$ Source: Cedergren, H.R., *Seepage, Drainage, and Flow Nets*. 1967.

= 12.5 ft^3/dy/(ft h)/(ft L)

Objective: Scenario 2: Surficial Aquifer overlies impermeable base aquitard

Estimate the seepage per foot of head difference and per foot of levee length.

Assumptions:

1.	Surficial aquifer thickness	(b)	120	ft		Source: Table 2, TP 80-4, SFWMD
2.	Surficial Aquifer hydraulic conductivity	(k)	40	ft/dy		Source: Table 3, TP 80-4, SFWMD
	Seepage per foot of head per foot of levee	(q)				
	Length of levee	(L)	1	ft	(unit length)	
	Head difference	(h)	1	ft	(unit head difference)	
	No. of flow paths	(N_f)	4		(see flow net diagram)	
	No. of potentiometric drops	(N_p)	6		(see flow net diagram)	

q = $k * N_f/N_p * h * L$ Source: Cedergren, H.R., *Seepage, Drainage, and Flow Nets*. 1967

= 26.7 ft^3/dy/(ft h)/(ft L)

Objective: Select representative seepage rate

Floridan Aquifer is likely underlying the site to a thickness of up to 20 ft (Plate 6, TP 80-4, SFWMD).

Assume base is permeable, use q = 15 ft^3/dy/(ft h)/(ft L)

Objective: Worst-case conditions - outflow

Estimate the seepage out of the PSTA test cells when adjacent seepage canal is at elev. 11.msl and PSTA cells are full.

Assumptions:

1.	Ground surface elevation in PSTA cells	z_1	=	16.25	ft msl	Source: USACE design drawings
2.	Max depth of flow in PSTA cells	d_1	=	2.75	ft	Source: Burns & McDonald dry out
3.	Max water surface elevation (SAV)	z_2	=	$z_1 + d_1$		
			=	19.0	ft msl	
4.	Water surface elevation Seepage Canal	z_3	=	11.0	ft msl	Source: STA 1E Water Ctrl Plan
5.	Max head difference	Δh	=	$z_2 - z_3$		
			=	8.0	ft	
6.	Length of PSTA perimeter levee	L	=	3900	ft	Source: USACE design drawings
7.	Seepage out of PSTA cells	Q	=	$q * \Delta h * L$		
			=	4.68E+05	ft^3/dy	
			=	5.42	cfs	

Conclusions:

Seepage out of PSTA cells into adjacent seepage canal is ~ 5 cfs.

Objective: Worst case conditions - inflow

Estimate the seepage into the PSTA test cells when adjacent SAV cells are at maximum depth and PSTA cells are dry.

Assumptions:

1.	Ground surface elevation in SAV cells	z_1	=	15.75	ft msl	Source: USACE design drawings
2.	Max depth of flow in SAV cells	d_1	=	1.85	ft	Source: Burns & McDonald dry out
3.	Max water surface elevation (SAV)	z_2	=	$z_1 + d_1$		
			=	17.6	ft msl	
4.	Top of substrate elevation in PSTA cell	z_3	=	z_1 + 0.5 ft		PSTA substrate 0.5 ft thick
			=	16.25	ft msl	
5.	Max head difference	Δh	=	$z_2 - z_3$ = 1.35	ft	
6.	Length of PSTA perimeter levee	L	=	3,900	ft	Source: USACE design drawings
7.	Seepage into PSTA cells	Q	=	$q * \Delta h * L$		
			=	7.90E+04	ft^3/dy	
			=	0.91	cfs	

Conclusions: Seepage into PSTA cells from adjacent SAV cells is < 1 cfs.

Objective: Worst case conditions - outflow with silty sand overburden

Objective: Worst case conditions - outflow with silty sand overburden

Estimate the seepage out of the PSTA test cells when adjacent seepage canal is at elev. 11.0 ft, NGVD29 and PSTA cells are full.

Assumptions:

Assume that permeability of silty sand is much less than underlying limestone; seepage is approximated by assuming vertical flow through silty sand, then 2-dimensional flow through aquifer, as calculated above. Flow

1.	Surficial silty sand permeability	(k)	=	1.00E-04	cm/sec	Source: typical silty sand
			=	2.83E-01	ft/dy	
2.	Thickness of silty sand overburden	(d)	=	21	ft	
3.	Maximum head difference	Δh_1	=	6.8	ft	Iterative assumption until total head loss below matches 8.0 ft.
4.	Effective width of seepage zone	B	=	200	ft	
5.	Length of PSTA perimeter levee	L	=	3900	ft	
6.	Seepage out of PSTA cells	Q	=	k * (Δh / d) * (L*B)		
	(assumes vertical seepage only)		=	7.14E+04	ft^3/dy	
			=	**0.83**	**cfs**	
7.	Head loss through aquifer	Δh_2	=	Q/q/L		
			=	1.2	ft	
8.	Total head loss	Δh	=	$\Delta h_1 + \Delta h_2$		
			=	8.00	ft	Matches total head difference

Conclusions:

If surficial silty sand is >20 ft thick, then seepage from PSTA test cell to adjacent seepage canal < 1 cfs

APPENDIX B.2

Estimated Head Loss through PSTA Demonstration Cell

	Maximum test flow	Average test flow
PSTA cell length	3,900 ft	3,900 ft
PSTA cell width	520 ft	520 ft
Flow depth	2.75 ft	2.00 ft
Hydraulic retention time	3.5 days	7.0 days
Levee side slope	3 H : 1 V	3 H : 1 V

Flow (cfs) (Q)	18.44 cfs	6.71 cfs
Wetted perimeter	537 ft	533 ft
Area of channel	1,453 ft^2	1,052 ft^2
Hydraulic radius (R)	2.70 ft	1.98 ft
Length of channel (l)	3,900 ft	3,900 ft

Energy slope (S) S = ((n*Q)/ ((R^.667)*1.486*A))^2

Friction head loss (hf) hf = s * l

Four different Manning's *n* values were used to show a range of head losses.

Mannings *n*	0.04	0.04
Energy slope (S)	3.10E-08	1.19E-08
Friction head loss	1.21E-04 ft	4.63E-05 ft

Mannings *n*	0.3	0.3
Energy slope (S)	1.74E-06	6.68E-07
Friction head loss	6.80E-03 ft	2.61E-03 ft

Mannings *n*	1	1
Energy slope (S)	1.94E-05	7.42E-06
Friction head loss	7.55E-02 ft	2.90E-02 ft

Mannings *n*	1.5	1.5
Energy slope (S)	4.36E-05	1.67E-05
Friction head loss	1.70E-01 ft	6.51E-02 ft

APPENDIX B.3

PSTA Stop-log Flow Calculations over the Weir for a 4 ft Weir Length.

Flow over Weir Q=C*L*H^1.5

Stop-log riser length = 4 ft

H (ft)	C	L (ft)	Per Barrel Q (cfs)		Total Cell Q (cfs)
0.2	2.63	4	0.94	x3	2.82
0.3	2.63	4	1.73	x3	5.19
0.4	2.63	4	2.66	x3	7.98
0.5	2.63	4	3.72	x3	11.16
0.6	2.63	4	4.89	x3	14.67
0.7	2.63	4	6.16	x3	18.48
0.8	2.63	4	7.53	x3	22.58
0.9	2.63	4	8.98	x3	26.95
1	2.63	4	10.52	x3	31.56
1.1	2.63	4	12.14	x3	36.41
1.2	2.63	4	13.83	x3	41.49
1.3	2.63	4	15.59	x3	46.78
1.4	2.63	4	17.43	x3	52.28
1.5	2.63	4	19.33	x3	57.98
1.6	2.63	4	21.29	x3	63.87
1.7	2.63	4	23.32	x3	69.95
1.8	2.63	4	25.41	x3	76.22
1.9	2.63	4	27.55	x3	82.65
2	2.63	4	29.76	x3	89.27

Calculations made assuming an unsubmerged weir with free discharge.

APPENDIX B.4

Back-Check for Water Surface Elevations in PSTA Test Cells

Test cell water surface (WS)	Cell bottom + 2.75 ft
Test cell WS	16.25 ft + 2.75 ft
Test cell WS	19.0 ft
WS at culvert exit	Test cell WS + exit loss
WS at culvert exit	19.0 ft + 0.02 ft
WS at culvert exit	19.02 ft
WS after stop-log riser	WS at culvert exit + friction loss+ bend loss
WS after stop-log riser	19.02 ft + 0.046 ft + 0.025 ft
WS after stop-log riser	19.091 ft
Boards on stop-log riser	WS after stop-log riser + board clearance
Boards on stop-log riser	19.091 ft + 1.0 ft
Boards on stop-log riser	20.091 ft
WS before riser	Boards on stop-log riser + hydraulic head
WS before riser	20.091 ft + 0 .7 ft
WS before riser	20.791 ft
WS at culvert entrance	WS before riser + friction loss + bend loss
WS at culvert entrance	20.791 ft + 0.042 ft + 0.031
WS at culvert entrance	20.864 ft
WS in SAV cell	WS at culvert entrance + entrance loss
WS in SAV cell	20.864 ft + 0.01 ft
WS in SAV cell	20.874 ft

Levee height in SAV cell	21.5 ft
WS in SAV cell	20.874 ft
Levee freeboard	0.626 ft

Notes:

1 ft water was added to the board height in the stop-log calculation to ensure free discharge over the boards, preventing a partially submerged condition.

The 0.042 ft and 0.046 ft values used in the WS calculation before and after the stop-log riser are for the friction losses in the barrels.

Bend losses are calculated from where the water needs to go through a 90-degree bend in the riser barrel.

Hydraulic head over weir taken from stop-log flow calculations for a 4 ft weir length (Appendix B.3) and maximum test flow of 18.44 cfs (Appendix B.2).

APPENDIX C
WATER QUALITY DESIGN CALCULATIONS (DMSTA MODEL)

Sample Input Page for Case 9 DMSTA Runs

DMSTA Input Values

Warning: One or More Cells Outside of Calib. Range

Case Description: STA 1-E, Cell 1 all EAV, add 50 Ac SAV Cell 2, JGF 6/15/05
EAV Constant Depth = 3' = 91.44 cm, SAV = 3' = 91.44 cm
Tp In = 214 ppb, Steady state
Case 9

Filename: DMSTA_Case 3.xls

Input Variable	Units	Value
Design Case Name	-	Sim
Starting Date for Simulation	-	01/00/00
Ending Date for Simulation	-	01/00/00
Starting Date for Output	-	01/00/00
Steps Per Day	-	5000
Number of Iterations	-	2
Output Averaging Interval	days	1
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.0%
Flow-Wtd Conc - With Bypass	ppb	61.4
Flow-Wtd Conc - Without Bypass	ppb	61.4
Geometric Mean Conc	ppb	61.3
95th Percentile Conc	ppb	67.6
Freq Cell Outflow > 10 ppb	%	100%
Bypass Load	%	0.0%

Cell Number -->		**1**	**2**	**3**	**4**	**5**	**6**
Cell Label	-	Cell 1	Cell 2 SAV				
Vegetation Type	------->	EMERG	SAV				
Inflow Fraction	-	1	0				
Downstream Cell Number	-	2	0				
Surface Area	km2	2.080	0.202				
Mean Width of Flow Path	km	1.52	0.15				
Number of Tanks in Series	-	1	1				
Outflow Control Depth	cm	91.44	91.44				
Outflow Coefficient - Exponent	-	1.5	1.5				
Outflow Coefficient - Intercept	-	0	0				
Bypass Depth	cm	0	0				
Maximum Inflow	hm3/day	0	0				
Maximum Outflow	hm3/day	0	0				
Inflow Seepage Rate	(cm/d) / cm	0	0				
Inflow Seepage Control Elev	cm	0	0				
Inflow Seepage Conc	ppb	20	20				

Outflow Seepage Rate	(cm/d) / cm	0.0018	0.0018					
Outflow Seepage Control Elev	cm	0	0					
Max Outflow Seepage Conc	ppb	20	20					
Seepage Recycle Fraction	-	0	0					
Seepage Discharge Fraction	-	0	0					
Initial Water Column Conc	ppb	30	30					
Initial P Storage Per Unit Area	mg/m2	400	400					
Initial Water Column Depth	cm	91.44	91.44					
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*12*					
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*					
K = Net Settling Rate at Steady State	m/yr	*16*	*128*					
Zx = Depth Scale Factor	cm	*60*	*60*					
C0 - Periphyton	ppb	*0*	*0*					
C1 - Periphyton	ppb	*0*	*0*					
K - Periphyton	1/yr	*0.00*	*0.00*					
Zx - Periphyton	cm	*0*	*0*					
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*					
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*					
Output Variables	**Units**	**1**	**2**	**3**	**4**	**5**	**6**	**Overall**
Execution Time	seconds/yr	353.47	695.15					695.15
Run Date	-	06/15/05	06/15/05					06/15/05
Starting Date for Simulation	-	01/01/04	01/01/04					01/01/04
Starting Date for Output	-	01/01/04	01/01/04					01/01/04
Ending Date	-	01/31/04	01/31/04					01/31/04
Output Duration	days	31	31					31
Cell Label		Cell 1	Cell 2 SAV					Total Outflow
Downstream Cell Label		Cell 2 SAV	Outflow					-
Surface Area	km2	2.080	0.202					2.3
Mean Water Load	cm/d	6.5	64.3					5.9
Max Water Load	cm/d	6.5	64.3					5.9
Inflow Volume	hm3/yr	49.5	47.5					49.5
Inflow Load	kg/yr	10587.1	3768.0					10587.1
Inflow Conc	ppb	214.0	79.4					214.0
Treated Outflow Volume	hm3/yr	47.5	47.3					47.3

Treated Outflow Load	kg/yr	3768.0	2903.0	2903.0
Treated FWM Outflow Conc	ppb	79.4	61.4	61.4
Total Outflow Volume	hm3/yr	47.5	47.3	47.3
Total Outflow Load	kg/yr	3768.0	2903.0	2903.0
Total FWM Outflow Conc	ppb	79.4	61.4	61.4
Bypass Volume	hm3/yr	0.00	0.00	0.00
Bypass Load	kg/yr	0.00	0.00	0.00
Bypass Conc	ppb	0.0	0.0	0.0
Bypass Load	%	0%	0%	0%
Surface Outflow Load Reduc	%	64.4%	23.0%	72.6%
Outflow Geometric Mean - Daily	ppb	79.3	61.3	61.3
Outflow Geo Mean - Composites	ppb	79.3	61.3	61.3
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%
95th Percentile Outflow Conc	ppb	86.2	67.6	67.6
Mean Biomass P Storage	mg/m2	746	764	748
Max Reservoir Storage	hm3	0.00	0.00	0.00
Reservoir Load Reduction	%	#N/A	#N/A	#N/A
Mean Depth	cm	91.4	91.4	91.4
Minimum Depth	cm	91.4	91.4	91.4
Maximum Depth	cm	91.4	91.4	91.4
Frequency Depth < 5 cm	%	0.0%	0.0%	0.0%
Flow/Width	m2/day	85	851	153.2
Max 1 Yr Flow-Wtd Conc	ppb	#N/A	#N/A	0.0
Max 5 Yr Flow-Wtd Conc	ppb	#N/A	#N/A	0.0
Max 1 Yr Geometric Mn Conc	ppb	#N/A	#N/A	0.0
Max 5 Yr Geometric Mn Conc	ppb	#N/A	#N/A	0.0
Depth Percentile vs. Calib Set	%	92%	78%	78%
Q/W Percentile vs. Calib Set	%	25%	394%	394%
Cin Percentile vs. Calib Set	%	113%	81%	113%
Cout Percentile vs. Calib Set	%	74%	69%	69%
Depth Range Flag	-	OK	OK	0.0
Q/W Range Flag	-	OK	FLAG	1.0
Cin Range Flag	-	FLAG	OK	1.0
Cout Range Flag	-	OK	OK	0.0
Water Balance Error	%	0.00%	0.00%	0.00%
Mass Balance Error	%	0.00%	0.00%	0.00%

Sample Error Page for Case 9 DMSTA Runs

Warning & Error Messages

Cell 1 inflow conc outside of calibration range

Cell 2 flow/width outside of calibration range

Sample Series Data for Case 9 DMSTA Runs

Input/Output Time Series user inputs are red

Case: Test

Date	Inflow cfs	Conc ppb	Rain inches	ET inches	Outlet Control Depth (optional) feet
01/01/04	55.32	214.00	0.16	0.20	
01/02/04	55.32	214.00	0.16	0.20	
01/03/04	55.32	214.00	0.16	0.20	
01/04/04	55.32	214.00	0.16	0.20	
01/05/04	55.32	214.00	0.16	0.20	
01/06/04	55.32	214.00	0.16	0.20	
01/07/04	55.32	214.00	0.16	0.20	
01/08/04	55.32	214.00	0.16	0.20	
01/09/04	55.32	214.00	0.16	0.20	
01/10/04	55.32	214.00	0.16	0.20	
01/11/04	55.32	214.00	0.16	0.20	
01/12/04	55.32	214.00	0.16	0.20	
01/13/04	55.32	214.00	0.16	0.20	
01/14/04	55.32	214.00	0.16	0.20	
01/15/04	55.32	214.00	0.16	0.20	
01/16/04	55.32	214.00	0.16	0.20	
01/17/04	55.32	214.00	0.16	0.20	
01/18/04	55.32	214.00	0.16	0.20	
01/19/04	55.32	214.00	0.16	0.20	
01/20/04	55.32	214.00	0.16	0.20	
01/21/04	55.32	214.00	0.16	0.20	

Sample Input Page for Case 10 DMSTA Runs

DMSTA Input Values

Input Variable	Units	Value	Case Description:		Filename:	DMSTA_Case 10.xls
Design Case Name	-	Sim	STA 1-E, EDC = 70 Ac FAV, 1 Inflow, JGF 6/15/05 FAV = 5.0' = 152.4 cm, EAV Depth = 3.0' , SAV Depth = 3.0'			
Starting Date for Simulation	-	01/00/00				
Ending Date for Simulation	-	01/00/00	Tp In = 214 ppb, Steady State			
Starting Date for Output	-	01/00/00	Case 10			
Steps Per Day	-	5000	**Output Variable**	**Units**	**Value**	
Number of Iterations	-	2	Water Balance Error	%	0.0%	
Output Averaging Interval	days	1	Mass Balance Error	%	0.0%	
Reservoir H2O Residence Time	days	0	Flow-Wtd Conc - With Bypass	ppb	29.8	
Max Inflow / Mean Inflow	-	0	Flow-Wtd Conc - Without Bypass	ppb	29.8	
Max Reservoir Storage	hm3	0	Geometric Mean Conc	ppb	29.8	
Reservoir P Decay Rate	1/yr/ppb	0	95th Percentile Conc	ppb	31.4	
Rainfall P Conc	ppb	10	Freq Cell Outflow > 10 ppb	%	100%	
Atmospheric P Load (Dry)	mg/m2-yr	20	Bypass Load	%	0.0%	

Cell Number -->		**1**	**2**	**3**	**4**	**5**	**6**	
Cell Label	-	Cell 1 FAV	Cell 1 EAV	Cell 1 SAV				
Vegetation Type	------->	None	EMERG	SAV				
Inflow Fraction	-	1	0	0				-
Downstream Cell Number	-	2	3	0				-
Surface Area	km2	0.283	2.080	0.202				
Mean Width of Flow Path	km	0.55	1.52	0.15				
Number of Tanks in Series	-	1	1	1				
Outflow Control Depth	cm	152.4	91.44	91.44				
Outflow Coefficient - Exponent	-	1.5	1.5	1.5				
Outflow Coefficient - Intercept	-	0	0	0				
Bypass Depth	cm	0	0	0				
Maximum Inflow	hm3/day	0	0	0				
Maximum Outflow	hm3/day	0	0	0				
Inflow Seepage Rate	(cm/d) / cm	0	0	0				
Inflow Seepage Control Elev	cm	0	0	0				
Inflow Seepage Conc	ppb	20	20	20				

Outflow Seepage Rate	(cm/d) / cm	0.0018	0.0018	0.0018				
Outflow Seepage Control Elev	cm	0	0	0				
Max Outflow Seepage Conc	ppb	20	20	20				
Seepage Recycle Fraction	-	0	0	0				
Seepage Discharge Fraction	-	0	0	0				
Initial Water Column Conc	ppb	30	30	30				
Initial P Storage Per Unit Area	mg/m2	400	400	400				
Initial Water Column Depth	cm	152.4	91.44	91.44				
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*12*				
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*				
K = Net Settling Rate at Steady State	m/yr	*124*	*16*	*128.20*				
Zx = Depth Scale Factor	cm	*91.44*	*60*	*60*				
C0 - Periphyton	ppb	*0*	*0*	*0*				
C1 - Periphyton	ppb	*0*	*0*	*0*				
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*				
Zx - Periphyton	cm	*0*	*0*	*0*				
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*				
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*				

Output Variables	**Units**	**1**	**2**	**3**	**4**	**5**	**6**	**Overall**
Execution Time	seconds/yr	353.47	706.94	1060.40				1060.40
Run Date	-	06/25/05	06/25/05	06/25/05				06/25/05
Starting Date for Simulation	-	01/01/04	01/01/04	01/01/04				01/01/04
Starting Date for Output	-	01/01/04	01/01/04	01/01/04				01/01/04
Ending Date	-	01/31/04	01/31/04	01/31/04				01/31/04
Output Duration	days	31	31	31				31
Cell Label		Cell 1 FAV	Cell 1 EAV	Cell 1 SAV				Total Outflow
Downstream Cell Label		Cell 1 EAV	Cell 1 SAV	Outflow				-
Surface Area	km2	0.283	2.08	0.202				2.6
Mean Water Load	cm/d	47.9	6.5	63.8				5.3
Max Water Load	cm/d	47.9	6.5	63.8				5.3
Inflow Volume	hm3/yr	49.5	49.1	47.1				49.5
Inflow Load	kg/yr	10587.1	3473.7	1649.6				10587.1
Inflow Conc	ppb	214.0	70.8	35.1				214.0
Treated Outflow Volume	hm3/yr	49.1	47.1	46.9				46.9

Treated Outflow Load	kg/yr	3473.7	1649.6	1394.8		1394.8
Treated FWM Outflow Conc	ppb	70.8	35.1	29.8		29.8
Total Outflow Volume	hm3/yr	49.1	47.1	46.9		46.9
Total Outflow Load	kg/yr	3473.7	1649.6	1394.8		1394.8
Total FWM Outflow Conc	ppb	70.8	35.1	29.8		29.8
Bypass Volume	hm3/yr	0.00	0.00	0.00		0.00
Bypass Load	kg/yr	0.00	0.00	0.00		0.00
Bypass Conc	ppb	0.0	0.0	0.0		0.0
Bypass Load	%	0%	0%	0%		0%
Surface Outflow Load Reduc	%	67.2%	52.5%	15.4%		86.8%
Outflow Geometric Mean - Daily	ppb	70.6	35.0	29.8		29.8
Outflow Geo Mean - Composites	ppb	70.6	35.0	29.8		29.8
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%		100%
95th Percentile Outflow Conc	ppb	78.7	36.7	31.4		31.4
Mean Biomass P Storage	mg/m2	3140	492	483		783
Max Reservoir Storage	hm3	0.00	0.00	0.00		0.00
Reservoir Load Reduction	%	#N/A	#N/A	#N/A		#N/A
Mean Depth	cm	152.4	91.4	91.4		98.2
Minimum Depth	cm	152.4	91.4	91.4		98.2
Maximum Depth	cm	152.4	91.4	91.4		98.2
Frequency Depth < 5 cm	%	0.0%	0.0%	0.0%		0.0%
Flow/Width	m2/day	245	85	855		163.1
Max 1 Yr Flow-Wtd Conc	ppb	#N/A	#N/A	#N/A		0.0
Max 5 Yr Flow-Wtd Conc	ppb	#N/A	#N/A	#N/A		0.0
Max 1 Yr Geometric Mn Conc	ppb	#N/A	#N/A	#N/A		0.0
Max 5 Yr Geometric Mn Conc	ppb	#N/A	#N/A	#N/A		0.0
Depth Percentile vs. Calib Set	%	#N/A	92%	78%		78%
Q/W Percentile vs. Calib Set	%	#N/A	25%	396%		396%
Cin Percentile vs. Calib Set	%	#N/A	69%	44%		#N/A
Cout Percentile vs. Calib Set	%	#N/A	42%	36%		36%
Depth Range Flag	-		OK	OK		0.0
Q/W Range Flag	-		OK	FLAG		1.0
Cin Range Flag	-		OK	OK		0.0
Cout Range Flag	-		OK	OK		0.0
Water Balance Error	%	0.00%	0.00%	0.00%		0.00%
Mass Balance Error	%	0.00%	0.00%	0.00%		0.00%

Sample Error Page for Case 10 DMSTA Runs

Warning & Error Messages

Cell 3 flow/width outside of calibration range

Sample Series Data for Case 10 DMSTA Runs

Input/Output Time Series user inputs are red

Case: Test

Date	Inflow cfs	Conc ppb	Rain inches	ET inches	Outlet Control Depth (optional) feet
01/01/04	55.32	214.00	0.16	0.20	
01/02/04	55.32	214.00	0.16	0.20	
01/03/04	55.32	214.00	0.16	0.20	
01/04/04	55.32	214.00	0.16	0.20	
01/05/04	55.32	214.00	0.16	0.20	
01/06/04	55.32	214.00	0.16	0.20	
01/07/04	55.32	214.00	0.16	0.20	
01/08/04	55.32	214.00	0.16	0.20	
01/09/04	55.32	214.00	0.16	0.20	
01/10/04	55.32	214.00	0.16	0.20	
01/11/04	55.32	214.00	0.16	0.20	
01/12/04	55.32	214.00	0.16	0.20	
01/13/04	55.32	214.00	0.16	0.20	
01/14/04	55.32	214.00	0.16	0.20	
01/15/04	55.32	214.00	0.16	0.20	
01/16/04	55.32	214.00	0.16	0.20	
01/17/04	55.32	214.00	0.16	0.20	
01/18/04	55.32	214.00	0.16	0.20	
01/19/04	55.32	214.00	0.16	0.20	
01/20/04	55.32	214.00	0.16	0.20	
01/21/04	55.32	214.00	0.16	0.20	

APPENDIX D
STA DESIGN GROUP COMMENTS AND RESPONSES

Response to Comments Submitted by STADG on the June 2005 *Draft Design Analysis Report* for Cell 2

September 7, 2005

STADG Comment	Response
COMMENTS FROM WSI	
During nearly four years of research funded by the SFWMD, CH2M HILL studied the growth and performance of periphyton-dominated plant communities on a variety of inorganic and organic substrates and over a wide range of mesocosm scales. Those efforts illustrated the importance of initial substrate conditions on colonization by calcareous periphyton. Of specific relevance to the USACE STA-1E PSTA project, the SFWMD research found that substrates with significant concentrations of available phosphorus were rapidly invaded by rooted macrophytes (especially cattails) and by filamentous green algae as opposed to blue green algal mats. Emergent macrophyte invasion and elevated nutrient levels in these test systems competitively excluded development of oligotrophic calcareous periphyton mats.	Agreed. This relationship was postulated by Doren and Jones (January, 1996) in their letter to COL Terry Rice "Conceptual design of periphyton-based STAs" and incorporated in the USACE's initial Periphyton Storm Water Treatment Area (PSTA) design document January 2000 and the USACE's 404 permit for the construction of all of the STAs. It was demonstrated experimentally and in the field at the USACE FCRTF and at USACE and DOI funded research sites in ENP at the C-111 Spoil Mound Removal Project. In addition to the letter and the later experimental and field demonstrations, further details concerning the PSTA concept were presented during meetings on June 27, 1996, October 25, 1996 and December13, 1996 by Dr. R.D. Jones and were incorporated into and paraphrased in several DOI reports by Dr. Kadlec (October 21, 1996 and November 28, 1996) and more comprehensively by Drs. Kadlec and Walker (December 26, 1996 and November 11, 2003). The SFWMD/CH2M HILL studies mentioned in this comment we believe demonstrated the same results in that rooted macrophytes were limit in their spatial extent by substrates with low phosphorus content. Additionally, this relationship can be inferred from the presence of calcareous periphyton communities within the natural Everglades and its disappearance in areas where the phosphorus concentrations in the soil and water are elevated only slightly above background levels.
Total phosphorus determinations are not equivalent to determinations of available phosphorus. Leaching studies are needed to determine the water soluble available phosphorus in these substrates. It is recommended that the USACE conduct phosphorus leaching tests on all of the substrates being considered for use in these test cells and on the native soils in the cells.	It has been demonstrated by the USACE at the FCRTF and by the Village of Wellington that a simple measure of TP is less complicated and more useful as a measure of available phosphorus for the microbial communities that form the periphyton mat. We are considering more comprehensive testing, experimentation, and monitoring of phosphorus species as part of the FCRTF and for the Field Scale Demonstration project. This information will be further detailed within the Monitoring Plan. Additional comments on the Draft Monitoring Plan would be welcomed.

STADG Comment	Response
The binding potential of the phosphorus is of paramount importance in substrate selection. The EPC_0 test was found to be the best indicator of the potential for release of sediment-bound phosphorus in response to variable water column phosphorus concentrations. For example a low EPC_0 indicates that the substrate will exchange phosphorus to the water column under conditions of low dissolved phosphorus concentrations in the water column while a high value indicates that the phosphorus is more tightly bound and will not readily exchange with the water even at higher ambient water concentrations. It is recommended that the USACE conduct EPC_0 tests of all of the substrates and underlying soils that will be used in these test cells.	We agree in concept, but disagree that this type of testing is necessary prior to construction of the demonstration project. We are considering more comprehensive testing, experimentation, and monitoring of phosphorus binding/affinity (pKa and Ks) constants and equilibrium concentrations of phosphorus species as part of the FCRTF and for the Field Scale Demonstration project. This information will be further detailed within the Monitoring Plan.
Sparse populations of rooted macrophytes were found in the SFWMD research to be beneficial for anchoring calcareous periphyton mats against wind and currents. Submerged aquatic macroalgae (*Chara* sp.) was also found to be a compatible partner with periphyton. Sparse macrophyte and macroalgae populations are only achievable with low antecedent available soil phosphorus concentrations, relatively low input concentrations of dissolved phosphorus, and with water level control. It is also very advantageous to plant macrophyte species that are able to compete under those conditions. Various species of spikerush (*Eleocharis* spp.) planted at fairly wide spacing (>1 m) are recommended. Under more fertile conditions spikerush populations will develop stem densities that limit periphyton mat development. Stem density for this species can be regulated to some extent by water depth. In the SFWMD research, deeper water depths up to 90 cm significantly lowered spikerush stem densities compared to shallower water for a given substrate type. It is recommended that the USACE specifically describe their plan for installing and controlling emergent and submerged macrophytes and macroalgae in the proposed PSTA test cells.	We agree in concept but disagree that this planting is necessary for a successful demonstration of PSTA. Please see the response to the first question as this relationship has been considered from the initial conceptual letter written to COL Rice. Macrophyte planting is considered an unnecessary expense. The scale of this project makes it more amenable to natural colonization than a mesocosm study. Using a limerock substrate with low TP is assumed to be the major control mechanism for macrophytes. However, it should be noted that sparse macrophytes (both EAV and SAV) are advantageous in that they provide additional surfaces for periphyton colonization. One of the parameters to be determined for the 3 substrates used in the Field Scale Demonstration will be the growth and development of the macrophyte communities. Macrophyte growth enhancement and control measures will be further detailed in the operations and monitoring plans. Additional comments will be welcomed on those documents.

STADG Comment	Response
Water hyacinth (*Eichornia crassipes)* and duckweed (*Lemna* spp.) are the primary floating aquatic vegetation (FAV) species that have been used in large-scale water quality treatment applications. Water lettuce (*Pistia stratoides*) and pennywort (*Hydrocotyle* spp.) are sometimes secondary dominants in communities of FAV but have not been used as managed vegetation in treatment systems except at the mesocosm level. High sustained phosphorous mass removal rates with water hyacinth and duckweed have been observed only in studies with regular plant management (harvesting), wind protection, and additions of essential macro- and micro-nutrients (nitrogen, iron, etc.). Duckweed has not been successfully used for phosphorus removal at the relatively low concentrations that will be experienced in the USACE STA-1E project. These observations indicate that water hyacinth is the only FAV that might actually be applicable as a dominant candidate FAV species for pre-treatment as envisioned in Appendix D. It is recommended that the discussion in Appendix D be corrected to identify water hyacinth as the intended dominant FAV species.	Your comments concerning FAV and our responses have been incorporated into our Letter Report on Floating Aquatic Vegetation Within the East Distribution Cell, where appropriate. We appreciate your comments concerning FAV. A review of the literature demonstrates that there is evidence of extensive use of *Pistia stratiote*s in water treatment systems world wide. We would agree that the scale of use is not well defined for any FAV system including *Eichornia crassipes.* To the best of our knowledge the STAs are the largest treatment wetlands ever constructed for phosphorus removal. The proposed enlarged FAV area in the EDC (170 acres as opposed to the 70 acres originally presented in the DAR) is believed to be the first large scale use of FAV for phosphorous removal and many operation and maintenance needs will be determined from this area. The dominant FAV species within the STA 1-E Eastern Distribution Cell (EDC) is *Pistia stratiotes*. Other FAV species that have naturally colonized the EDC include *Azolla sp*. and *Eichornia crassipes*. However, the areal extent of these species comprises approximately 1% of that of *Pistia stratiotes*. A discussion of the other genera, including *Eichornia crassipes*, is unnecessary as they are not being considered for use. It is agreed that harvesting could increase the mass removal of phosphorus, as it would for any of the biological communities/genera used or proposed for use in the STAs. While harvested systems may require the addition of macro-and micro-nutrients, we do not believe that addition of these limiting nutrients will be necessary to sustain a standing crop of *Pistia stratiotes*. *Pistia stratiotes* is also able to grow in a wider range of nutrient levels than *Eichornia crassipes* especially at the lower concentration ranges. Since we are not attempting to produce a harvested product with nutritional value as animal feed, composting, or in methane production, the addition of nutrients is not a critical concern either. Finally, we are using the same process that involves the accretion of sediment or soil as the final removal/long term sink for the mass removal of phosphorus.

STADG Comment	Response
Research conducted at Wellington included water hyacinth harvesting and very small cells (0.12-ac) that protected the plants from significant wind fetch movements. Research with water hyacinths at the S-154 Managed Aquatic Plant (MAPS) system included highly managed water hyacinth populations in fairly small cells (2.5-ac) with continuous harvesting and included significant additions of macro- and micro-nutrients. The plan outlined in Appendix D includes a 70-ac water hyacinth treatment system. This scale for a highly-managed water hyacinth water quality treatment system has never been found to be practical to-date in Florida or elsewhere. The largest system to-date was the 30-ac polishing FAV system at Orlando's Iron Bridge Wastewater Treatment Facility. That system was abandoned after just a few years of operation and the required plant management and system maintenance has been termed a "nightmare" by the operators. Harvesting of water hyacinth at the proposed 70-ac scale is not feasible. Neither is nutrient addition. Plant establishment and coverage in this cell will be variable due to wind, pests, and nutrient deficiencies. The conclusion that follows from these observations is that the proposed FAV system will not be managed or harvested and will consequently operate at an efficiency lower than the other studies that are cited in the literature review. The only exception to this conclusion is the use of an average settling rate from the unmanaged ENR Buffer Cell. It is recommended that the 124 m/yr settling rate used by the USACE in their DMSTA simulation be replaced with a value of about 60–70 m/yr based on the average ENR data. A significantly larger FAV pre-treatment area will likely be required to meet the phosphorus goal.	See the response to the previous comment. Any discussion of size is irrelevant as the FAV component of the STA-1E PSTA Field Scale Demonstration Project will be used to determine treatment parameters. We agree that if we were proposing a highly managed harvested system, the approximately 170 acre area in FAV would likely be impractical. We do agree that there are complicating factors associated with wind rafting during establishment of the FAV. However, once the community has sufficient coverage this should be less of a problem. Unlike harvested systems this system will not require an open water grow out area. In order to reduce construction costs and optimize FAV performance the proposed FAV portion of the EDC now compromises approximately 170 acres. The FAV component of the Iron Bridge WWTF as a polishing cell is noted and is in fact one of the reasons we do not propose to have a highly managed harvested system as part of this project. FAV is proposed to be the initial step and not used for "polishing" in the EDC of STA-1E. The settling rate used by the USACE in their DMSTA simulations, was based on the ENR operating period when the HRTs in the Buffer Cell were sufficiently long enough to insure a water velocity that did not resuspend the bottom sediment. If the entire ENR data set is used for the Buffer Cell the settling rate drops to the 60-70 m/yr range. We feel that it is inappropriate to use the data from the ENR when the HRTs were insufficient to prevent bottom scouring. However, the increased size of the FAV area of the EDC of STA-1E provides a safety margin for lower settling rates. The actual settling rates, and operational and maintenance needs for FAV will be determined as part of this project.

STADG Comment	Response
As suggested previously, an Operations and Monitoring Plan needs to be developed and peer reviewed prior to start-up of the facilities. The June 2005 DAR lacks a significant amount of information that is necessary to fully understand and comment upon the proposed project. Many of the reviewers' previous comments have not been sufficiently answered and the USACE report indicates that those comments will be addressed in the Operations Plan.	The Monitoring and Operations plans are being prepared and will be forwarded to STADG in the near future.
There are numerous references to the expectation that the inflow water will have a phosphorus concentration less than 50 parts per billion (ppb). While many of the existing STAs routinely achieve this level of treatment, there are instances where outflow concentrations exceed 50 ppb. Will inflows to the PSTA system be shut down if outflows from Cell 1 exceed 50 ppb? The adaptability and reliability of the PSTA system should be evaluated for a range of inflow conditions that include "upsets" in the upstream components. The DAR notes in the comment section that PSTA communities were successfully developed at the Flying Cow site at inflow concentrations exceeding 100 ppb. If this is the case, why is 50 ppb being emphasized as some threshold value for project success?	An upper threshold of total phosphorus concentrations of 30 to 50 ppb has been established due to multiple criteria. The original genesis of this target concentration is 62-302.540, FAC as this technology is intended to compliment existing systems. Prolonged inflow concentrations above 30 to 50 ppb will prompt changes in the operations of the treatment train supplying water to PSTA as that is unsustainable for marl depositing periphyton communities. However, it is anticipated that no action will be taken if the TP in the inflows to the PSTA cells represent spikes due to natural variability as described in this comment. This project should help further define these conditions.
It would be helpful to have a table of design flows showing the average, median, minimum, and maximum. It would also be informative to have a graph showing the frequency distribution of anticipated hydraulic loading rates to the PSTA cells rather than the time series plots and hydraulic retention time plots contained in the DAR.	This will be included in the Operations Plan.
Responses to previous comments state that depth effects will be established at the Flying Cow site, yet this document indicates that close grading tolerances are required so that the "effect of water depth on PSTA treatment effectiveness can be tested." Do the data from the Flying Cow project provide any guidance on depth relationships? Further, the DAR indicates that depth effects can be evaluated by adjusting stop log elevations while operating at constant flow per unit width. This changes the depth, the hydraulic residence time, and the linear velocity. How can depth effects then be isolated from the effects of hydraulic residence time or velocity?	The FCRTF data indicates that depths greater than 2 ft inhibit the development of the Periphyton mat. However once the mat is established the mats continue to develop at depths of 2 ft. Interrelated and covarying parameters are universal in ecological studies; numerous statistical methods are used to group and separate these parameters. We expect that PSTA, in a semi controlled hydrologic environment, when subjected to the same analyses, will present no greater problems than the natural Everglades.

STADG Comment	Response
Outflow concentrations in a variety of wetland treatment technologies including periphyton-dominated systems have been shown to be more strongly correlated with inflow mass loading rates than with hydraulic residence time. Why is the focus of this proposed project on residence time and depth, rather than on loading rate?	We agree, however, the concentration on residence time and depth are quite relevant in the design of this project. Concrete hydrologic data is available while the level of confidence in TP concentrations required for calculation of mass loading rates is lower. However, data to draw these correlations will be gathered. A significant part of the concentration based model (CBPSTAM) that is being developed as part of this effort will consider mass loading, HRT, Q, Z, V, TP concentrations, other physical, and physiochemical parameters as variables at this time. No order of importance has been assigned.
Control of the system will be difficult with adjustable inlet and outlet structures in place. We assume that each cell is anticipated to receive the same flow. Assuming that the bypass culvert (from the SAV cell to the remainder of Cell 2) functions as intended, the inlet weirs serve no clear purpose and will make it more difficult to manage flows and water levels than just having the downstream structures. In our experience, stop log structures are inadequate and problematic.	Your comments have been noted. Stop log structures have been used successfully in many systems. Our experience with these structures is that they perform adequately and with few problems. In addition, having multiple stop log structures at both the influent and effluent of the PSTA channels will give us additional control and allow us to activate the PSTA, and optimize the upstream treatment and PSTA independently of the remainder of the treatment train.
Have the designers verified that the bypass culvert will operate without backwater effects from Cell 2?	The SAV cell will always have a higher surface water elevation than the Cell 2 bypass area.
Manning's equation is not valid for the laminar to transitional flows observed in wetland systems. Where adaptations to Manning's have been developed for STAs, the "n" values can be considerably higher than the values used in this document.	Laminar flow is expected within most of the PSTA cells due to the lack of emergent vegetation. Please refer to Appendix A.2 for the impacts of varying values.
The SAIC document cited for the selection of substrates should be provided as an Appendix to the DAR, along with reports and data for the Flying Cow project.	This document (March 7, 2005 Memorandum) was appended to the DAR.
What level of emergent macrophyte growth will be allowed in the PSTA cells, how will it be monitored, and how will excessive growth be managed?	These items will be addressed within the Monitoring and Operations Plans.

STADG Comment	Response
The DAR includes a table of proposed flow rates as a function of selected depths and average hydraulic retention times. In most instances of wetland flow, depth is controlled by frictional resistance rather than by the outlet weir elevation. Have the designers confirmed that the target combinations of depth and flow rate are achievable?	Yes, this has been considered.
COMMENTS FROM SFWMD	
Limiting flows to cells 1 and 2 and impacts to overall performance of STA-1. This issue is the number 1 comment in Chip's earlier letter. While your response indicates that the PSTA field-scale demonstration would be operated at flows and loadings typical of STA-1E, we still have concerns, particular without the benefit of seeing the operation plan. In particular, the report does not shown the intended range of inflows through the water quality treatment train (FAV in the east distribution cell, EAV in cell 1, SAV in north section of cell 2, and PSTA cells). The report does show an intended test range of flows through the PSTA cells with a "maximum test flow" of 18.44 cfs per cell. This would be 55.3 cfs for the PSTA cells. My current understanding of the project is that the test flows would go through the aforementioned treatment train and that the rest of cell 2 would not be used other than maintained at a stage to limit seepage impacts to/from the PSTA cells. What's unclear, and may be cleared up in your operation plan, is what happens (a) when you are not conducting "tests" and (b) when the proportionate share of S-319 inflows for cells one and two (based on area) is above 55.3 cfs. The latter situation would be whenever S-319 is discharging above 277 cfs, since cells one and two comprise about 20% of the treatment area. I believe your response is that event (when S-319 is above 277 cfs daily flows) is infrequent. Figure 5 (Inflows via S-319) shows that this occurs 13% of the time, and based on the data in the figure, this would be over 40% of the volume that enters the STA during the DOA study.	The comments will be considered during the development of the Operations Plan. The Operations Plan will be forwarded to the STADG in the near future.

STADG Comment	Response
High upstream stages for maximum test stage of 20.87 feet in PSTA. This issue is the number 2 comment in Chip's earlier letter. Your response is that this is for very short periods of time when a few specific tests are being run. What's unclear though is how the system will be operating when tests are not being run and when inflows approach the maximum test rate of 55.3 cfs for the PSTA cells. Wet season events may require flows near these ranges for longer than short durations. One way to avoid the need to maintain higher upstream stages is to provide a pump at the headwaters of the PSTA cells to maintain stages in PSTA while letting normal stages for the flow condition to exist in the east distribution cell and cell 1.	The comments will be considered during the development of the Operations Plan. The Operations Plan will be forwarded to the STADG in the near future.
Utilization of remainder of cell 2. If I understand the plan correctly, most of cell 2 would not be used for treatment of flows. Maybe this would justify revisiting with Dr. Goforth his recommendation of using the remainder of cell two as the headwater into the PSTA cells.	The comments will be considered during the development of the Operations Plan. The Operations Plan will be forwarded to the STADG in the near future.
Design conditions for the statement "Each culvert has been designed for a maximum 10 year DOA flow rate of 95 cfs." This is my previous comment no. 12. This was discussed after the meeting on August 3 and I believe Jay said it should have been 95 cfs for each cell. Please clarify and also provide the hydraulic design information for the culverts when passing the maximum D0A flow rate.	Agreed, it is 95 cfs for each cell. Please refer to Appendices A.2 and A.3.
COMMENTS FROM L. SCINTO	
As in any biological treatment (including those with a large abiotic component) there will be seasonal variations in physiological rates. In a large extent of the Everglades periphyton biomass maximizes around October with significant reductions in growth through the winter months. Will the design allow for manipulation of flow rates (reducing flow) to allow for the reduced physiological activity? How does this fit into the plan to operate at dynamic flows?	The Operations Plan will reflect seasonality of flows.

STADG Comment	Response
What are the suspected relationships between depth, flow velocities, P concentrations, and other hydrologic/chemical influences and the ability of periphyton to retain P (and sequester it long term)? How would these relationships change if there was a species shift towards green algae due to excessive P and how would the system be maintained or reset?	This comment was previously addressed in the response to the last set of comments.
States substrates must have low carbon content (no peats) but in many places in Everglades marl is forming on top of peat soils. Can this be tested in FCRTF or other facility to see what parameters/conditions would have to be forced to get this to happen? It may not be feasible to develop PSTA on Typha-generating (impacted peat) but it might be possible on sawgrass-supporting peat as we see all over the Everglades. A good test might be peat with sawgrass and some small amount of limed material to produce $CaCO_3$ saturating conditions.	This comment was previously addressed in the response to the last set of comments.

<u>Response to Comments Submitted by STADG on the April 2005 First *Draft Design Analysis Report* for Cell 2</u>

	STADG Comments on April 2005 Draft DAR	Response
	Comments from Chip Merriam	
1	Designing the demonstration project to accept full-scale flows and nutrient loads will ensure that the results will be directly applicable to full-scale implementation. Unfortunately, the draft Design Analysis Report indicates that the maximum flow through the cells will only be 20% of the full-scale peak flow. A related concern is the potential flow restriction through both Cells 1 and 2 resulting from the demonstration project's stated requirement to have a maximum inflow concentration of 50 ppb at the inlet to Cell 2. Any significant restriction of flow through these cells, which comprises about 20% of the entire STA-1E treatment area, would likely impact the performance and flood control purpose of the STA-1E project as a whole. This would have ramifications on permit compliance, Settlement Agreement compliance and related matters; perhaps we should bring this to the attention of the Settlement Agreement Principals for their review. We would be happy to discuss an alternative configuration that isolates PSTA demonstration project flow path from the balance of Cells 1 and 2 and therefore minimize overall treatment area disruption.	Flows entering the PSTA cells are to be managed to achieve 30 ppb TP at inflow. The PSTA field-scale demonstration would be operated at flows and loadings typical of STA-1E. Flow regimes consisting of 3.5, 7, and 14 days are tentatively planned. USACE is investigating alternatives that would minimize limiting flows to Cell 1. During the PSTA testing phase, Cells 1 and 2 will be operated to facilitate the testing process. During major storm events, flows will be coordinated with the water management district to assist flood protection and, if necessary, the PSTA tests will be temporarily suspended during such events.

STADG Comments on April 2005 Draft DAR		Response
2	The draft Design Analysis Report indicates an upstream stage of 20.87 feet NGVD would need to be maintained for the maximum flow to the demonstration project. This stage is more than 1.25 feet higher than the maximum stage projected during the design of STA-1E, which raises the concerns regarding the ability to maintain this stage and what effect it may have on the Cell 1 and Cell 2 perimeter levees, please have your staff look into this.	This situation is being reviewed. Preliminary analysis shows that there are no stability issues with the levee and a higher water stage. This stage would be maintained for very short periods of time when a few specific test conditions are being run and then lowered once the test is complete. It may be possible to lower water stages if the stop-log risers are operated as submerged weirs; however, in that situation, monitoring of flow with gauges will be required.
3	The operations of the demonstration project's proposed water control structures require manipulation of flashboards, and this will likely be an intensive operations requirement. Please confirm that the Corps or their contractors will be responsible for the day-to-day operations of the PSTA project. If you would like SFWMD staff to operate this facility, there would likely need to be significant changes to the proposed design.	USACE or its contractors will be responsible for the day-to-day operations of the PSTA project's water control structures; however, collaboration with SFWMD in regard to STA-1E operations will be required.
	Comments from Jim Sturgis	
1	Who is going to operate and maintain new facilities?	Operations, monitoring, and maintenance of the PSTA Demonstration Facility will be the responsibility of USACE and its contractors.
2	There are many operational issues that are not discussed, such as how the STA will be operated during peak flow conditions, how the STA will be operated to produce 50 ppb TP outflow from Cell 1, how cells 1 and 2 are to be operated with a PSTA by-pass structure in cell 2, etc. Operations need to be addressed in the design not after the PSTA design is complete as suggested at the PSTA meeting held on April 8, 2005.	The original schedule of activities provides for development of both Operations and Monitoring Plans prior to completion of the facility construction. Future STADG meetings will address both operations and monitoring of the PSTA demonstration cells. Comments on the draft documents will be solicited at that time in a similar manner to the *Design Analysis Report*.
3	No analysis of rainfall events is provided. Consideration in the design should be given to local rainfall events particularly over PSTA cells	Rainfall has already been incorporated into the design. Rainfall is a component of the dry-out analysis used in the design of the PSTA Demonstration Facility.
4	While not part of this DAR, the design needs to include an access plan to the site for construction and O&M. The plan should include requirements for improving and/or maintaining existing facilities and dust control. The construction site and existing access road is adjacent to Village of Wellington residential community. Need to consider potential off site impacts from construction activities as well as local ordinances, e.g., noise and work hours.	Primary access into Cell 2 will be via ramp, being constructed near the Southeast corner of Cell 2. Dust control and working hours will be part of the construction contract.

STADG Comments on April 2005 Draft DAR		Response
5	Show as built cross sections of cell 2. This data would be helpful to determine seepage between cell 2 and PSTA. In addition, previous information made available by the USACE show the west side of the remainder of cell 2 (after PSTA cells built) to be about one foot lower than the east side of the remainder of cell 2. What will be the new average ground elevation in the remainder of cell 2? Will there be short circuiting if the west side is one foot lower? Could grading (cut of high side of the remainder of cell 2) be done as a source of fill for PSTA levees?	The only construction activity planned will occur in the east 1/3rd and north of Cell 2. Levee construction material will come from a borrow pit of approximately 20 acres located just north of the PSTA demonstration cells. Short-circuiting in the western portion of Cell 2 is not anticipated with respect to the PSTA demonstration located to the east. After the testing is complete, the demolition potentially can include filling the remaining low spots in Cell 2. This determination has not yet been made.
6	Page 4 (Figure 3). Eighteen stop logs structures are proposed (six per test cell). Why do you need so many structures? If required, would this mean 48 structures would be needed if project later expanded to all of cell 2? SFWMD would need the control structures to be automated/telemetry for us to operate	Three stop-log structures are proposed at each inlet or outlet to allow flexibility and sensitivity in controlling flow, smaller log sizes for easier maintenance, and redundancy. The use of stop-log structures is only for the purpose of the test demonstration project; stop-log structures are not proposed for permanent operations in STA-1E and would not be expanded to other cells. Operations, monitoring, and maintenance of the PSTA Demonstration Facility will be the responsibility of the USACE and its contractors.
7	Page 5 (Table 1). Section 2 of Table 1 states "For the draft DAR obtain currently available STA-1E monitoring data to indicate treatment to at least 50 ppb. If verified, use this number as the PSTA cell input concentration." Was this done?	Available data was obtained; however, it was insufficient to determine PSTA cell input concentrations, due to both very few data points and STA operations at the time of data collection.
8	Page 6 (first paragraph). Correct the layout description to show that eastern embankment of Cell 2 is Levee L-85, not L-6.	Agreed. Change will be made in next revision.
9	Page 6 (second paragraph). The design subgrade elevation is not specified. The bottom elevation of the PSTA cells is shown on the drawings as 16.25 feet, after adding 0.5 feet of material to the subgrade. This would mean that the subgrade is 15.75 feet. The scatter gram on Cell 2, provided to us by the USACE, shows average elevation in the eastern third of Cell 2 is closer to 16.0 feet.	Please refer to the final design drawings. The design bottom elevation of the PSTA cells is 16.25 ft, after adding 0.5 ft of material to the subgrade. The average elevation in the eastern third of Cell 2 is closer to 15.75 ft. The finished grade in all three test cells is at 16.25 ft elevation. Primarily the earthwork needed for balancing cut/fill determined this elevation.
10	Page 6 (fourth paragraph). This paragraph states that the top elevation of internal PSTA levees is set at 19.0 feet, which is the same elevation as the maximum demonstration water surface, so no freeboard is provided. [Note: cross section on plate w202 shows 19.5 feet for internal levees.] Please verify the design minimum freeboard, and if using the levee road during maximum demonstration water levels is planned.	The typographical error on p. 6 will be corrected to state that the levee elevations were set at a minimum of 19.5 ft mean sea level. Minimum freeboard (0.5 ft) was provided because of the temporary nature of the facility and the cost to construct levees with higher freeboard. In case of levee failure, the waters would discharge internally to Cell 2 without impairing permanent perimeter levees; the temporary internal levees would be repaired at that time as a contingent measure.

STADG Comments on April 2005 Draft DAR		Response
11	Page 7 (last paragraph). Manual control of water depths and flow rates through each PSTA cell is provided. See comment 6 above.	Correct. See response to comment 6 above. Manual control is only for the demonstration project and would not be proposed for permanent operations in STA-1E.
12	Page 8 (first full paragraph). The text states "Each culvert has been designed for a maximum 10 year DOA flow rate of 95 cfs." What culverts? Hydraulic analysis in appendix A shows 18.44 cfs maximum test flow through each PSTA cell, 6.16 cfs per barrel. Clarify what condition and provide hydraulic design. Also, please clarify what is the peak design flow through the PSTA cells. Is it 55.3 cfs? (Three times maximum test flow?) Is it 290 cfs? (Proportionate share of peak design flow for cells 1 & 2, 860 cfs?) Is it 87.4 cfs? (Proportionate share of the 7 day average outflow from Cell 2 as modeled in the DOA?)	Peak hydraulic capacity flow was designed to be 860 cfs for all of Cell 2; 95 cfs for each test cell (proportionate share of 860 cfs). Each 36-inch culvert comprising a stop-log structure is designed to handle the entire 95 cfs, which provides a factor of safety. The maximum flow scenario to be tested is a steady-state condition at 2.75 ft depth, 3.5-day retention time, which equates to 18.44 cfs for each test cell. It is agreed that this is less than the proportionate share of the 7-day average outflow from Cell 2. The maximum 7-day average outflow for Cell 2 is 260 cfs; proportionate share would be 28.6 cfs in one test cell. Volumes during such peak storm surges (approximately one storm per year as shown on Figure 8) will not be tested.
13	Page 8 (first full paragraph). An additional culvert is proposed to by pass flows from the PSTA SAV cell to the rest of Cell 2. What is the design flow for this structure? How will this operation impact the rest of Cell 2? Is this planned to be automated / telemetry control?	The bypass culvert is needed only if operation of the S-364-A gate is temporarily impaired. Design flow is 95 cfs. The culvert is manually controlled during test operations and would be used only if needed.
14	Page 9 (first paragraph). The design pumping rate of S-319 is 3980 cfs, not 3600	Change will be made in next revision.
15	Page 9 (fourth paragraph). This paragraph describes Figure 9, Hydraulic Retention Time in Cell 2. What is the purpose of this analysis? How does this relate to flows, depths and HRTs in the PSTA cells? What are the HRT design parameters for PSTA?	The PSTA cells will be the last in a series of aquatic vegetation cells. It is anticipated that these cells will rise to 2.75 ft maximum with a minimum HRT of 3.5 days. HRT is better represented by discharge rates than inflow rates, but algorithms are being developed to properly calculate HRT. The major factors affecting HRT calculations during high flow conditions are that the inflow rate is restricted by the pumping rate, there is flow attenuation in the cells due to rising water surface elevations, and the outflow rates will be restricted by control structures with possible tailwater effects. Seven-day averaging was utilized to represent the discharge timespan for a storm to recover the storage within the STA. The results of this analysis were used to establish the 3.5-day HRT as the minimum to be expected. The flows for the test scenarios were then calculated based on the physical sizes of the cells, the HRT, and the maximum depth.
16	Page 9 (fifth paragraph). Same comment as no. 15 above	Figure 10 is a design tool. The purpose of this figure is to demonstrate the effects of water depth and flow rate on HRT. This graph is for all of Cell 2, but is proportional to the test cells by volume.

STADG Comments on April 2005 Draft DAR		Response
17	Page 17 (first paragraph). This paragraph describes maximum (17.59 feet) and average (16.39) water surface elevation in cell 2 from the DOA. Please explain what purpose this information is being used for in the design of the PSTA project. Other pertinent information would include the elevation (18.16 feet average) in cell 2 under maximum design inflows (steady state) found in the May and November 2000 Addendum to Design Documentation Report (Revised Draft) STA-1E, USACE, Jacksonville District. Also, the remainder of cell 2 is now planned to be operated as SAV, so between storms the control elevation would be approximately 1.25 feet above average grade, except during startup the depth would be 2.0 feet above grade.	The elevation data is informational. Thank you for the additional informational data. USACE will control the remainder of cell 2 for the duration of the PSTA test. The operational depth of Cell 2 will be used to control seepage.
18	Page 17 (third paragraph). Seepage units should be cubic feet per day (cfd) instead of cubic feet per second (cfs). The text states that maximum head of 1.84 feet between cell 2 and PSTA cell was used to calculate seepage flows into PSTA while Appendix A1 uses 1.35 feet. This example is being used as the worst case scenario, but will PSTA cell be operated to be dry during peak flow conditions?	Units will be changed in the next revision of this report. The text will be revised to 1.35 ft. In addition, calculations will be added for seepage out of the PSTA cells. Operations of the PSTA cells will be addressed in the upcoming Operations Plan. Future STADG meetings will address both operations and monitoring of the PSTA demonstration cells. Comments on the draft documents will be solicited at that time in a similar manner to the *Design Analysis Report*.
19	Page 17 (fourth paragraph). The text states a maximum test flow of 18.44 cfs was used to calculate head loss through a PSTA cell. Is that the maximum flow through PSTA cell during peak flow conditions in the STA? If so, please describe how the peak flow will be distributed. The proportional share of the peak flow for the 1680 ft. wide PSTA is 289 cfs, while the maximum flow through the PSTA is 55 cfs, leaving 234 cfs to go somewhere.	The maximum flow scenario to be tested is a steady-state condition at 2.75 ft depth, 3.5-day retention time, which equates to 18.44 cfs for each test cell. Peak flow (hydraulic capacity) during storm event was designed to be 860 cfs to Cells 1 and 2, 95 cfs for each test cell (proportionate share of 860 cfs).
20	Page 18 (first paragraph, continued from page 17). Text states, based on head loss calculations for maximum test flow conditions, a water surface elevation of 20.874 feet would be needed to be maintained in SAV cell upstream of the PSTA cell. I could not find how this elevation would be maintained. Control elevation in cell 1 would be 18.05 feet (1.25 feet above average ground of 16.81 feet, USACE as built surveys) and peak flow elevation would be 19.56 feet (average cell value, November 2000 Addendum to DDR). Tail water at S-364 (cell 1 discharge structures) under peak flow conditions is 18.50 feet (November 2000 Addendum to the DDR). These design elevations are much lower than the recommended 20.874 feet in the PSTA SAV cell. Also, for L-85 levee, exterior levee on east side of cell 2, the levee height (23.5 feet) was determined by adding 5.0 feet of freeboard to peak flow water surface elevations in cell 2. Under the proposed plan, there would only be 2.6 feet freeboard in the SAV cell upstream of the PSTA cells. Please explain the basis of the new design. Lastly, the stability analysis design of levee L-85 should also be checked for the proposed PSTA water surface elevations.	This situation is being evaluated. Preliminary analysis shows that there are no stability issues with the levee and a higher water stage. This stage would be maintained for very short periods of time when a few specific test conditions are being run and then lowered once the test is complete. It may be possible to lower water stages if the stop-log risers are operated as submerged weirs; however, in this situation, monitoring of flow with gauges will be required.
21	Page 18 (third full paragraph). The text states that water from cell 1 should have a total phosphorus concentration less than 50 ppb. How will this be done? What would be the impact on rest of STA and long term plan? What happens if cell 1 discharge is greater than 50 ppb?	The Operations Plan will provide the details of the flow to Cell 1 required for the demonstration. This operating plan can be used to estimate the impact on the remainder of the STA.

STADG Comments on April 2005 Draft DAR		Response
22	Page 19. Due to concerns about calcium (hardness) in discharges from STA, suggest also monitoring changes in calcium (hardness) concentration to make sure no adverse impacts.	Calcium concentrations will be addressed in the upcoming monitoring report.
23	Appendix A.3. This appendix notes that it will be difficult to inspect culverts and that vegetation and other debris could clog culverts. What will be done to prevent clogging of PSTA culverts? We are constructing vegetation barriers in front of the gated box culverts in STA-1E.	It is proposed that there will be a floating boom in front of the stop-log risers to prevent any floating vegetation from getting around the inlet structures. The barrels of the stop-log risers are also designed to be submerged, which would prevent floating vegetation from entering the barrels and fouling the boards. The velocities in the system are such that any non-floating vegetation that would occur in a size sufficient to hinder stop-log operations would have settled out in the test cell.
Comments from Gary Goforth		
1	page 1 para 1: i. The project description is outdated; with the Florida Legislative authority for implementing the 2003 Long-Term Plan (LTP), the STA is now being managed to encourage SAV in the downstream cells, with outflow phosphorus projected to achieve a flow-weighted mean of 15-24 ppb, and a geometric mean of 10-11 ppb. This projection is based on critical assumptions, including: ii. The inflows and loads are within the anticipated range described in the 2003 LTP (these estimates are being updated as part of the EAA Regional Feasibility Study); iii. STA performance will be similar to the performance of the calibration data sets (the calibration data sets and STA performance projections will also be updated as part of the EAA Regional Feasibility Study); iv. Cells 1 and 2 will capture and treat approximately 20% of the total inflow to the STA. As the SFWMD has stated from the inception of this PSTA demonstration project, the proposed PSTA project should be designed to meet this critical operational objective; if not, the STA performance and flood control purpose of the STA-1E project will likely be adversely affected. This has serious ramifications on permit compliance, Settlement Agreement compliance and related matters. Any proposed significant change to the STA-1E operations, as contemplated by this DAR, should be brought to the attention of the Technical Oversight Committee for their review and comment. v. In the same manner that the SFWMD designed its PSTA demonstration project in STA-3/4, the STA-1E PSTA pilot scale project should be designed to receive the full hydraulic and nutrient loading rate as the eventual full-scale application.	i. Consideration of the LTP is not a part of this demonstration project's objectives and was not included in the project description for this purpose. The final determination is unknown, but a successful demonstration of PSTA by USACE in STA-1E may be used as a best available technology for incorporation into the LTP. ii. USACE plans to operate the PSTA demonstration across various flow regimes and loading rates. iii. USACE plans to monitor the entire treatment train to establish treatment efficiencies of each of the components. This data may be added to the calibration data set. iv. Cells 1 and 2 have been designed to treat about 20% of the flow to the STA. The PSTA demonstration will evaluate all the flow regimes anticipated within STA-1E. During the PSTA testing phase, Cells 1 and 2 will be operated to facilitate the testing process. During major storm events, flows will be coordinated with the water management district to assist flood protection and, if necessary, the PSTA tests will be temporarily suspended during such events. v. The PSTA Demonstration Facility is being designed to determine the maximum hydraulic and nutrient loading rate of eventual full-scale application so that it may be properly scaled and situated within the STA.
2	page 1 last paragraph – what is the project schedule? i. design ii. construction iii. start-up iv. testing (18 months?) v. full-scale design vi. full-scale construction	Design: 30 June 2005 Construction: August 2005 – June 2006 Testing: June 2006 – January 2008 Full-scale design: TBD Full-scale construction: TBD

STADG Comments on April 2005 Draft DAR		Response
3	page 4 and response to my earlier comment on stop logs operation – Thanks for confirming that the Corps or its contractor be responsible for operating the control structures.	No response required.
4	pages 5 and 6 – Exactly how was the test cell width determined? What were the "Cell 1 and 2 constraints" referenced in the text? What values were used to achieve "equal flow distribution in Cell 2"? How will this width and area be scaled up to full-scale application?	Demonstration test cell sizing was determined after consideration of multiple factors. It became apparent that, due to the truncated nature of the Cell 1- 2 treatment train, Cell 1 would be incapable of achieving TP concentrations equal to or less than 50 ppb for flows required for the demonstration. Budget and land constraints prevented expanding the size of "SAV Cell" to achieve sufficient treatment to allow for expansion of the demonstration cells. Equal flow distribution was determined by the size of Cell 2 and the number of structures. The footprint of the test cells is equal to the input structure relative to the size of the cell. A concentration-based model will be developed as part of the demonstration that will be used to size a full-scale application.
5	page 6 – i. The tolerance noted in the text ("+/- 0.25 ft") is inconsistent with the tolerance noted on Plate No. W 203 ("+/- 1.5 inch"). Which is correct? ii. Is the proposed +/- 1.5-inch tolerance (shown on Plate No. W 203) for ground elevation anticipated to be carried forth into the full-scale design?	The typographical error in Table 1 and Section 2.1 will be revised to state a tolerance of +/- 0.125 ft; namely, a 3-inch total variation is tolerable. Grading tolerances will be evaluated at the time of full-scale design.
6	page 7 – i. What tolerance will be provided in the substrate material thicknesses? How will the contractors achieve a depth of 2 inches for the Fort Thompson Formation limestone and 1 inch for the lime sludge? ii. The unexcavated on-site limestone and the stockpiled on-site limestone have lower TP and $CaCO_3$ characteristics than the other two substrates, so why are the other two substrates (Fort Thompson Formation limestone and lime sludge) being used?	i. Construction specifications will stipulate "minimum" thickness of substrate, not a +/- tolerance. Thickness will be measured by pre- and post-surveys during material placement. Grading to tight tolerances can be achieved using laser grading equipment, such as used in road construction. Contractors using conventional construction equipment (graders, dozers) are capable of placing 2 inches of limestone. The construction contractor will demonstrate the feasibility and practicability of installing a 1-inch layer of lime sludge using agricultural lime spreaders or similar equipment. ii. Fort Thompson Formation limestone is being used as a baseline substrate that has successfully sustained calcareous periphyton utilizing C-51 canal source water. Lime sludge is a low-cost alternative that has been successfully demonstrated utilizing C-51 canal source water.

	STADG Comments on April 2005 Draft DAR	Response
7	page 8 – i. The proposed rock structures upstream of each outlet structure are not shown on the drawings – please provide more information on the dimensions and location of these. What hydraulic energy loss is anticipated as a result of these structures? How will this change the proposed 20.87 ft NGVD stage at the SAV cell exit? ii. SFWMD staff previously provided to the Corps a copy of the 31-yr (1965-1995) simulated daily time series of inflow to STA-1E for use in this and other STA-1E analyses; that is the time series used in preparing the 2003 LTP.	i. Rock structures have been replaced with floating booms and will be reflected in the next revision of this report. ii. USACE plans to test a range of flow regimes covered in the 31-year simulation.
8	page 17 – i. If I'm not mistaken, Burns and McDonnell estimated seepage rates for Cell 2 material – these values could be used as an initial estimate of the cross-talk. For example, if the seepage rate was 3 cfs/ft of head/mile of levee, with a head of 2.75 ft and a levee length of 3900 ft would yield a cross talk of 6 cfs – this is a high percentage of the maximum flow (18 cfs) and could impact the tests. ii. The unit for seepage rate (cfs/ft of head/ft of levee) is inconsistent with the unit used in Appendix A (cu ft per day/ft of head/ft of levee). iii. The seepage estimate from adjacent Cell 2 (<1 cfs) appears low; please confirm using estimates provided by Burns and McDonnell during the design of STA-1E levees. iv. Why was the maximum test flow limited to 18.44 cfs when the maximum Cell 2 flow was assumed to be 855 cfs? The proportionate peak flow for each test cell is 855 * (182/3) / 552 = 94 cfs. The test flow maximum is only 20% of this proportional flow, and will unnecessarily overburden the balance of Cell 2, violating the design objective in Table 1 ("equally distribute flow in Cell 2"), causing flow restrictions that will adversely impact adjacent cells and possibly adversely impact the flood control and water quality treatment objectives of the project. Not using full-scale hydraulic and nutrient loading rates appears to be a critical design flaw of the PSTA demonstration project.	i. Noted. The Burns & McDonnell estimates range from 10 to 30 cfd/ft/ft. Calculations in this document have estimated a range from 12.5 to 26.7 cfd/ft/ft. This shows close agreement. A value of 15 cfd/ft/ft was therefore chosen for estimating seepage rates. ii. The typographical error on units will be corrected. iii. The seepage rate estimates have been reviewed. Additional estimates of seepage out of the PSTA cells to the adjacent seepage canal have been made and would indicate higher (~5 cfs) seepage rates. During demonstration cell startup activities, a water budget will be developed, a tracer study will be conducted, and infiltration tests will be performed within the test cells. During demonstration cell operations, the water flowing into the test cells, the water flowing out of the test cells, and the depth of water within the test cells will be measured to estimate the net seepage loss/gain. iv. Correct. Peak flow (hydraulic capacity) was designed to be 860 cfs for all of Cell 2; 95 cfs for each test cell (proportionate share of 860 cfs). The maximum flow scenario to be tested is a steady-state condition at 2.75 ft depth, 3.5-day retention time, which equates to 18.44 cfs for each test cell. It is agreed that this is less than the proportionate share of the 7-day average outflow from Cell 2. The maximum 7-day average outflow for Cell 2 is 260 cfs; proportionate share would be 28.6 cfs in one test cell. Volumes during such peak storm surges (approximately one storm per year as shown on Figure 8) will not be tested.
9	page 18 - The proposed water surface elevation (20.87 ft) is 3.3 feet higher than the maximum stage estimated during the project design (17.59 ft). What impact does this have on the other hydraulic and civil features of the cells? For example, what stage will have to be maintained in Cell 1 to achieve this stage in Cell 2? Isn't the design criterion for the Cell 2 (and possibly Cell 1) eastern perimeter levee now not met with this higher stage?	This situation is being evaluated. Preliminary analysis shows that there are no stability issues with the levee and a higher water stage. This stage would be maintained for very short periods of time when a few specific test conditions are being run and then lowered once the test is complete. It may be possible to lower water stages if the stop-log risers are operated as submerged weirs, however, in this situation, monitoring of flow with gauges will be required.

STADG Comments on April 2005 Draft DAR		Response
10	page 18 – i. How was the TP limit of 50 ppb established? Is this an instantaneous limit, or an annual average maximum? Please clarify. ii. What is the proposal to maintain an upper limit of 50 ppb in the outflow from Cell 1? iii. Will 3-inch diameter limestone allow achievement of target thicknesses, e.g., 1 inch of Fort Thompson Formation limestone? iv. How were the added thicknesses shown on page 7 determined using the factors listed, i.e., native soil type, the amount of labile P in the native soil, and the TP concentration in the underlying groundwater? v. What are the projected phosphorus concentrations to be discharged from the test cells? How do these compare to the LTP projections? Will operation of the test cells worsen the overall STA performance when the flow restrictions in Cells 1 and 2, and resulting overloading of the other treatment cells are taken into account?	i. PSTA is a secondary treatment technology that is being designed to reduce phosphorus concentrations from 30-50 ppb to 10 ppb. It is currently envisioned that during full-scale implementation, it would be placed after a full treatment train (EAV-SAV), which is not available for Cells 1 and 2. Therefore, this concentration limitation is an artifact of the study site. Concentrations in excess of 50 ppb input concentrations are not sustainable over the long-term. Calcareous periphyton is an oligotrophic community that can be out-competed by other algal communities that form organic sediments that encourage the growth of emergent communities. More frequent dry-outs limit the competition of other algal species but reduce the availability of PSTA for water treatment. ii. TBD in the Operations Plan. iii. The construction contractor will demonstrate the feasibility and practicability of achieving this target thickness. Additionally, the material is 3-inch diameter and smaller (including fines associated with the crushing process). iv. Substrate thicknesses were determined based on results at FCRTF which uses STA-1E native soils underneath the PSTA substrate within three cells. v. USACE has designed the PSTA demonstrations cells to achieve 10 ppb TP at several different HRTs. The tests will achieve 10 ppb TP or better removal performance than indicated in the LTP. USACE will test PSTA over 18 months and will not worsen the overall performance of the STA, as it will achieve 10 ppb TP and will be in compliance with the Florida Statutes and Consent Decree.
11	What are the proposed operations for the various phases of the PSTA demonstration project? i. Start-up phase ii. Growth of SAV iii. Growth of periphyton iv. What indicator will be used to determine when this phase is complete? v. Testing phase vi. How many tests will be conducted? vii. What are the operating targets (depth, flow rates, inlet and outlet stop log operations, etc.) viii. What will the test durations be?	This comment is relevant to the Operations Plan. The original schedule of activities provides for the development of both Operations and Monitoring Plans prior to completion of the facility. Future STADG meetings will address both operations and monitoring of the PSTA demonstration cells. Comments on the draft documents will be solicited at that time in a similar manner to the *Design Analysis Report*.

STADG Comments on April 2005 Draft DAR		Response
12	Appendix A.3 i. The footnote identified a critical concern regarding the proposed configuration of the inlet/outlet pipes shown in Plate No. W 203: the risers are located approximately 30 feet inside the pipes, which will make it hard (impossible?) to inspect and maintain the culvert and risers. Suggest the risers be placed on the end of the pipes and a boardwalk constructed to manipulate the flashboards. ii. Is the weir equation appropriate for the proposed pipe/riser configuration? Does the 3-ft diameter pipe flow control or does the 4-ft weir control the flow? iii. Placing the pipes on the bottom of the collection canal will likely lead to flow obstruction due to sedimentation over time. Not sure the invert of the outlet 3-ft diameter pipe needs to be at 12.0 ft NGVD since the test cell ground elevation is 16.25 ft.	i. Noted. The current configuration is preferred. Vegetative growth and debris are expected to be minor and could be removed from the stop-log riser structure. Access to the culvert inlets remains the same. ii. The weir equation controls flow for the proposed pipe/riser system using the stated assumption that the weir will have free discharge with no submergence due to tailwater effects. If the system has to be run under a submerged condition, flow meters will need to be used to set the outflow from the barrels when adjusting the boards. For the flow levels required, if control switches to outlet control, the system will still be able to pass the required volumes. iii. The suggestion to raise the inverts a few inches off the bottom of the distribution channels will be considered.
13	Plate No. W 201 i. Test Cell note 1 indicates a final elevation of 16.25 ft plus 1 inch, while notes 2 and 3 call for a final elevation of 16.25 ft – this is probably a mistake, as it would give unequal cell elevations. ii. Drawing suggests cells will need to be excavated approximately 0.5 ft in order to place substrate to a new elevation approximately equal to the existing elevation (shown as 16.25 on Drawing W 202). A quick calculation (could be wrong) suggests this will yield about 3 million cubic feet of material, approximately twice what is needed for the test cell levees (average height 4.5 ft, 12-ft top width, 3:1 sideslope). What is the plan to dispose of this material?	i. The construction drawings have been revised to show top of finish grade at 16.25 ft, following placement of the 1-inch layer of lime sludge. The spreading of lime sludge cannot be graded when placed; therefore, the grade of demonstration Cell 2A is 16.25 ft, with the lime sludge variable thickness of 0.5 to 1.5 inches (average 1 inch). ii. Please refer to the final design drawings. The average elevation in the eastern third of Cell 2 is closer to 15.75 ft, so that a net cut/fill balance can be achieved.
14	What is the current cost breakdown for each of the construction features of the PSTA demonstration project, including demolition at the end of the test?	This project is 100% federally funded and is within the approved amount.
15	How was the size of the SAV cell determined? Was a forecast model such as DMSTA used? Couldn't the size of this SAV cell be increased (using DMSTA) to achieve and average of 50 ppb at the inlet to the PSTA test cells under the full-scale hydraulic and nutrient loading to the STA? Perhaps the excess material excavated from the test cell floors could be used to construct a new interior levee in Cell 1 (connecting just west of S-363C) to isolate the PSTA demonstration project flow path; this cell could be subdivided into an emergent followed by an SAV cell designed to achieve 50 ppb. The benefit of this alternative is that this eastern flow path could be isolated from the balance of cells 1 and 2 and minimize overall treatment area disruption.	The SAV cell is not considered a water treatment feature due to its small size and rapid changes in depth. It has been given this name, as SAV is expected to colonize this area. The size of the cell was generated by a need for material to construct the PSTA facility. Expansion of the SAV cell was considered cost prohibitive. Isolation of the PSTA facility from portions of Cell 1 would further exacerbate the problem of achieving 30 ppb within the truncated Cell 1 - Cell 2 treatment train.
16	How will SAV be established in the SAV cell?	The SAV cell is not considered a water treatment feature due to small size and rapid changes in depth. It has been given this name, as SAV is expected to colonize this area.
17	When will the operations plan and monitoring plan be developed?	A draft of these plans is expected to be available in July/August 2005.

STADG Comments on April 2005 Draft DAR		Response
18	With the PSTA demonstration project incorporating S-365B, will S-365A be able to pass the balance of the design flow through Cell 2?	This comment is relevant to the Operations Plan. The original schedule of activities provides for the development of both Operations and Monitoring Plans prior to completion of the facility. Future STADG meetings will address both operations and monitoring of the PSTA demonstration cells. Comments on the draft documents will be solicited at that time in a similar manner to the *Design Analysis Report*.

Response to Comments Submitted by STADG on the April 2004 *Draft Design Analysis Report* for Cell 4S

March 1, 2005

STADG Comment	Response
Comments from Bill Walker	
Given its scale, the project has the potential to contribute substantially to existing data on PSTA technology derived primarily smaller-scale experimental platforms (ENR Test Cells, STA-2 Field Scale) and observations of natural wetlands (C111, WCA-2A). Full-scale PSTA tests in STA-1E and STA-34 will help to fill the void of information from platforms that are representative of full-scale STA's with respect to size, flow velocities, water depth ranges, and pulsing regimes (Kadlec & Walker, 2003).	We agree that with proper monitoring scale-up of this technology should provide a wealth of information on how it could be implemented.
I suggest that further design efforts, as well as development of a monitoring and operations plan, consider information and concepts developed by SFWMD for the full-scale PSTA project in STA-34, as well as the smaller-scale PSTA research platforms. While the hydraulics and engineering details are not directly transferable to the STA-1E site, the basic design concepts, analytical approaches, constraints, operation strategies, and monitoring strategies are adaptable to the STA-1E project.	This information will be considered during future efforts when deemed applicable.
Interpretation of data from the smaller scale STA-1E experiment (Flying Cow Road facility) is difficult without tracer data to characterize mixing regimes Model calibration to the phosphorus profiles and any resulting scale-up calculations would be strongly dependent upon whether the sharp drops in concentration at the inlet zones of the experimental channels were attributed to uptake within those zones or to longitudinal dispersion.	Tracer studies will be conducted at the Flying Cow Road Test Facility (FCRTF). in the future.
The proposed experimental plan involving 2-week investigations of 24 different hydraulic regimes (depth x hydraulic residence time) in an 18-month period is impractical, given the expected time scales for adaptation of the periphyton and other ecosystem components to changes in these regimes and the potential difficulties in controlling the hydraulics in the context of full-scale STA operation. Even if the communities and performance were to equilibrate to each experimental regime, interpretation would be difficult because the manipulated hydraulic factors would be confounded with unknown seasonal factors unless each hydraulic regime can be tested for a full year.	A proposed operations plan has yet to be developed for Cell 2. The 24 different hydraulic regimes were used to simulate potential treatment efficiencies. However, the majority of experiments will be conducted utilizing dynamic flows proportional to the width of the treatment area based on the period of record.
Seepage may make it difficult to operate the facility at water levels that are significantly different from ambient, particularly without an outflow pump station for the PSTA cells (as included in the STA-34 PSTA design). Even if head differentials between adjacent cells can be maintained, the induced outflow or inflow seepage (cross-talk) may introduce undesirable artifacts. Furthermore, vegetative flow resistance will limit the extent to which water levels can be controlled by manipulating the inlet & outlet stop logs.	Current design efforts are focused on Cell 2, with internal levees extended to an existing canal within Cell 2. These two factors should limit the concerns expressed. The effects of groundwater inflow and outflow (crosstalk) and vegetative flow resistance will be further evaluated for Cell 2 during monitoring and operations phases of the project.
In the context of full-scale STA-1E operations, it will be more practical to focus on experimental manipulations of the average inflow per unit width (Q/W), as opposed to water depth (Z). For a fixed length cell, Q/W and Z determine the hydraulic residence time (HRT), velocity (L/ HRT), and hydraulic load (Q/A). While it may be possible and useful to perform some steady-flow experiments at different Q/W, operation in a fully dynamic mode would provide the most useful information for scale-up. Under dynamic operations, the average Q/W could be manipulated by diverting flow to the eastern portion of Cell 4B or by restricting inflow to Cell 3. Without an outflow pump station, the only practical way to manipulate the average depth of the PSTA cell may be to regulate the entire depth of Cell 4S. The feasibility of doing so without inducing excessive seepage is unknown.	It is agreed that Q/W and Z determine HRT. By manipulating the inlet and outlet stop-log heights, the experiment can look at fixed cell length and fixed Q/W, then vary Z to alter HRT. The effect of Z on phosphorus uptake can then be studied. The effects of seepage (crosstalk) will be further evaluated for Cell 2.

STADG Comment	Response
From a modeling perspective, there is only one driving variable (Q/A = hydraulic load), not two independent ones (Z and HRT). The steady state-solutions of the DMSTA PSTA model and the STA design model are independent of depth and HRT at a fixed Q/A. In order for performance to improve with increasing HRT at a fixed Q/A, the net settling rate would have to increase with water depth. No such depth dependence has been observed in PSTA experimental mesocosms. If anything, performance is more likely to deteriorate with an increase in depth at a fixed water load because flow velocities would decrease.	Agreed. The current planning effort in Cell 2 includes a significant effort to establish these relationships in the development of a concentration-based model. Depth dependence will be established at FCRTF.
The draft report justifies the experimental HRT regime based upon the time frequency distribution of hydraulic residence times in Cell 4S. It would be more appropriate to consider the percent of flow volume occurring at or below a given HRT (not percent of the time). The flow distribution would place greater emphasis on the shorter HRT range. For example, HRT values < 3.5 days are expected ~5% of the time but account for ~25% of the flow volume, based upon DMSTA simulations (see below). HRT values >20 days are expected ~50% of the time but account for only ~5 % of the flow volume.	Agreed. The percent of flow volume occurring at or below a given HRT is appropriate to consider, because the net phosphorus uptake will be calculated as a volume-weighted average. This frequency distribution will be presented in the Cell 2 analysis.
DMSTA simulations of the 24 experimental regimes were performed to forecast steady-state performance using a 14-day simulation period. Neither the simulations nor the actual system would be expected to equilibrate with to hydraulic conditions within a 14-day time frame (Kadlec & Walker, 2003, Figure 1). Model convergence may have been achieved in some of the 14-day simulations, but only because of a fortuitous choice of the biomass P storage at the start of each experiment. The latter will depend upon startup conditions and the sequence of experiments. Conservative assumptions are made with respect to inflow P concentration (50 ppb vs. ~30 ppb expected with Cell 4N converted to SAV (see below)) and a single stirred tank (i.e. the cells were assumed to be completely mixed). These would tend to produce pessimistic forecasts.	Equilibration within a periphyton-based system is faster than that found in a SAV or EAV system due to the rapid growth of microbial communities. However, the majority of experiments will be conducted utilizing dynamic flows proportional to the width of the treatment area, based on the period of record. Additionally, work will continue at FCRTF.

STADG Comment	Response
Another use of DMSTA for experimental design would be for evaluating the hydraulic and concentration regimes in the PSTA cells in the context of full-scale STA-1E operation. Tables 1-3 summarize model inputs and outputs for 31-year simulations using an input file adapted from the SFWMD Basin-Specific Feasibility Studies (Burns & McDonnell, 2002). The input time series represents predicted outflows from the buffer cell using C51W basin flows without the ACME Basin B diversion (not scheduled to occur within the time frame of the demonstration project). Simulations use the most recent model calibrations for non-emergent communities, based upon STA-1W Cell 4 and STA-2 Field-Scale PSTA data. Three model runs are provided: • Table 1. Entire STA-1E with outflows from the buffer cell distributed to provide uniform hydraulic load (Q/A) across all flow paths. • Table 2. Central flow path including Cells 3, 4N, 4S (PSTA portion only) The dimensions and flows to Cell 3 & 4N have been reduced by 50% to reflect the areas contributing to the PSTA cells. • Table 3 – Eastern flow path including Cells 1 and 2. Cell 2 is further subdivided into two sections (SAV in north, and PSTA in south). This was discussed as an alternative location for the PSTA demonstration project at the May 4 meeting. Results for the Cell 4S and Cell 2 PSTA locations are summarized below: DMSTA Simulations of PSTA in Cell 4S or Cell 2 Variable Units cell 4S Cell 2 Mean Hydraulic Load cm/d 7.0 7.5 Flow / Width m2/day 105 56 Mean Velocity cm/sec 0.21 0.13 Mean Depth cm 58 51 Min Depth cm 17 1 Max Depth cm 94 64 Hyd Resid Time days 8.2 6.7 Inflow P Flow-Weighted ppb 27 31 Outflow P Flow-Weighted ppb 19 23 Outflow P Geo. Mean ppb 10 12 These represent 31-year averages with the PSTA cells operated at ambient depths and flow velocities (i.e., without special manipulation) and assuming that SAV is successfully established upstream of each PSTA (Cells 3, 4N, 2N). Results indicate that geometric mean outflow concentrations on the order of 10 ppb are attainable at either location, but that flow-weighted values would be on the order of 20 ppb. Either site could therefore support a viable demonstration of PSTA technology. Potential sensitivity to experimental manipulation of the hydraulic loads and/or depths could be explored by modifying the outflow distribution from the buffer cell and/or outlet control depths.	This project is developing a concentration-based model to work in conjunction with the Dynamic Model for Stormwater Treatment Area (DMSTA) to predict the performance of PSTAs.
Hydraulic conditions and concentrations will vary considerably in the context of pulsed inflows. Experimental manipulation of the inflows may help to dampen some of these variations. Calibrating DMSTA to the experimental data would provide a basis for comparing results with other PSTA platforms and for forecasting long-term performance based upon the 18-month project results.	Agreed. Inflows and depths will be manipulated to provide experimental data as a basis for forecasting long-term performance.

STADG Comment	Response
The possibility of moving the experiment from Cell 4S to Cell 2 was discussed at the May 4, 2004 meeting. One potential advantage of the Cell 2 location is that it could be implemented with less disruption to full-scale STA-1E startup and operation. With balanced hydraulic loads, approximately 20% of the buffer cell outflow would be treated in the Cell2/1 path, as compared with 39% in the Cell 3/4N/4S path (B&M, 2002). There may also be better control of water depths during startup and operation using the seepage return canal adjacent to Cells 1 and 2. The simulations indicate a shallower depth regime in Cell 2, which may be more favorable for PSTA communities, (range 1 – 64 cm with occasional dryout), as compared with Cell 4S (17 – 94 cm, dryout not expected).	Agreed. Current plans are to locate the demonstration test plot in Cell 2.
The main disadvantage of the Cell 2 location is that the upstream treatment path is shorter, so the projected inflow and outflow concentrations are higher. This concentration range would be expected to decrease with experimental reductions in the inflow to Cell 1 or diversions around the PSTA cells. The full-scale model (Table 1) could be used to evaluate the potential impact of shifting the excess flows to other cells on the performance of the STA as a whole.	Noted. Inflows and depths will be manipulated by diverting around the demonstration test plot and controlling inflow and outflow stop-log heights. This will provide experimental data as a basis for forecasting long-term performance.
The 20-30 m/yr range pretty much brackets the expected settling rate based upon the SFWMD field-scale PSTA results. See **http://www.wwwalker.net/dmsta/track/psta_fsc\index.htm**. The steady-state model is limited by the fact that the system will be very dynamic. Inflow concentrations and loads will tend to be higher during periods of high flow. If you eliminate these peaks by regulating the flow, your experiment will be less realistic. It seems important to operate the facility with fully dynamic flows for at least a portion of the experiment.	The majority of experiments will be conducted utilizing dynamic flows proportional to the width of the treatment area based on the period of record. However, this can be accomplished only if sufficient treatment occurs within Cell 1 to attain total phosphorus concentrations below 50 ppb.
One concern is that the inflow concentrations may be higher than the 20-50 range simulated. This will depend on the length of the upstream flow path, upstream vegetation types, and flow regulation.	Inflow concentrations above the prescribed levels are a concern and will be addressed through the Operations Plan for Cell 1. The DMSTA will be used to determine the projected concentrations delivered within different Cell 1 operating conditions.
Table 3 of my previous comments shows DMSTA simulations with Cell 1 in emergent, 50% of Cell 2 in SAV, and 50% of Cell 2 in PSTA, the outflow concentration would be 12 ppb geometric mean and 23 ppb flow-weighted without upstream flow regulation (i.e. operated with the design hydraulic loads for the full scale STA). If Cell2 is 20% SAV and 80% PSTA, the inflow to Cell1 would have to be restricted to about 60% of the design flow in order to reach outflow 10 ppb geometric. The predicted flow-weighted inflow to the PSTA cell is 32 ppb. This seems OK, as long the facility is operated at full design hydraulic loads for a least a portion of the experiment. The width of the cells is adjustable to suit your economics (i.e. model forecasts are independent of width).	Noted. The experiment will test variable inflows and depths to provide experimental data as a basis for forecasting long-term performance. The demonstration test plot will be operated at the extreme flows in the period of record for at least a portion of the experiment. This project will then develop a PSTA model that will work in conjunction with the DMSTA for forecasting long-term performance.
Given the sandy soils, it seems desirable to operate the entire Cell 2 (inside and outside of the experiment) at the same water level, in order to minimize seepage exchange (thru and under levees) that could make the experimental results difficult to interpret. So, in order to get deeper water for SAV, you might have to excavate. The seepage return canal and pump should provide a way to recirculate flow and help to maintain SAV.	Agreed. Part of Cell 2 will be excavated to get deeper water for SAV, and the demonstration test plots in Cell 2 will be operated at approximately the same water level as often as possible.
I assume that you are planning to build a new north/south levee along the entire length of Cell 2 in order to isolate the SAV/PSTA flow path from the rest of the cell. The worst case scenario is that the experiment fails because it is designed assuming a greater degree of hydraulic control (flow/depth/seepage) than is possible. Even if the outflow P concentration is not 10 ppb, the data will be valuable for model calibration and scaleup calculations.	Agreed. A new north/south levee will be built along the entire length of Cell 2. If full hydraulic control is not achievable, then conditions will be monitored to determine actual flow/depth/seepage attained – that data will be valuable for model calibration.
Comments from Bob Knight and Chris Keller	

STADG Comment	Response
Based on the Corp's stated objective, the STA-1E PSTA project is intended to provide a demonstration of the large-scale feasibility of this technology. This project should utilize existing information for design of the PSTA configuration that is considered most likely to succeed and then test that design at a large scale using time-varying actual flows over a long duration. Short-duration tests with defined inflow rates and operating depths are best conducted at a pilot study scale and are not representative of full-scale operations.	Short-duration tests with defined inflow rates and depths will be conducted for only a short period of time to allow for correlation with pilot-scale experiments and for initial model calibration. The majority of the experiments will be conducted utilizing flows representative of full-scale operations.
As a demonstration project, operations should be representative of full-scale conditions. Side-by-side comparisons of substrates, steady-state flows and constant depths should be completed at a smaller scale such as the Corp's Flying Cow PSTA site.	A scaleup of the substrates previously demonstrated at the Flying Cow Road facility is being done to test the performance of these substrates at a larger scale. Alternatives to Fort Thompson limestone are being tested to evaluate cost savings.
A test duration of 3 weeks is insufficient, even at the pilot scale, and is not likely to yield information that is valuable for full-scale design and operations. It takes several residence times to purge the water from the previous test, and probably longer still to reach a new equilibrium once flows or depths are changed.	Noted. However, we disagree with this comment. The majority of Cell 2 experiments will be conducted utilizing dynamic flows proportional to the width of the treatment area, based on the period of record.
Estimates in the document indicate that seepage is expected to be negligible. This conclusion is reached based upon an assumed hydraulic conductivity for perimeter berm material that probably does not reflect post-construction conditions. All of the unlined PSTA-like platforms (S-332B, S-332D, SFWMD Field-Scale Cells) have experienced considerable seepage exchanges. Only a fraction of the total seepage is attributable to berm losses. The dominant portion of the seepage loss has been in the vertical direction.	The effects of groundwater seepage inflow and outflow (crosstalk), particularly in the vertical direction, will be further evaluated for Cell 2 during the operations and monitoring phases of the project. Infiltration is expected to occur and to be greatly impacted by operations of the remainder of the STA.
Hydraulic calculations do not consider the effects of head loss through the PSTA cells. The design team should confirm that the desired depths are feasible at the specified flow rates.	The effects of head loss and vegetative flow resistance will be further evaluated for Cell 2 during the operations and monitoring phases of the project.
Hydraulic coefficients in DMSTA model runs should be justified. A zero value for "b" is unrealistic, and indicates that there is no relationship between flow rate and depth. The value used for "a" (0.06) is well below any calibrated value from other STA or experimental platforms.	First, from the source [DMSTA.xls], the following may be noted: 1. No outflow below this water level (or constant depth) Zc 2. For computing outflow from depth (b), $q/w=a\ Z^b$ for Z> or= Zc (typically ~3.5) 3. Flow/width at water depth of 1 m (a), =0 for constant depth (typically 0.4 -1.2) The above suggests that b~3.5 and a=q/w=0.4 to 1.2 for Z> = Zc. In addition, q/w may be written in different forms. For example, $q/w=(aZ)\ Z^{(b-1)}$. Second, each scenario we considered was controlled and set to occur at a specified retention time (Tr) and a specified depth (d) in a cell. Consequently, the discharge (Q) through the cell with a specified area (A) was set to Q=A*d/Tr. Third, both Q and d were set for a scenario. The scenario did not require any explicit relation between Q and d (or Z); i.e., Q was modeled setting b=0 in order to set a=Q/w (where w=width of the cell). a= 0.06 was obtained from: Q=7.21 cfs and w=917 ft yielded a=Q/w=0.06 $(hm^3/day)/km$ ($1hm^3$ = 1 million cubic meters).
Have the anticipated operating conditions for upstream and adjacent cells been considered when specifying a 6-inch water depth for the PSTA cells? There is likely to be a backwater effect that will impact water levels in the PSTA cells.	Please note that the demonstration test plots will now be constructed in Cells 1 and 2. Therefore, there will no longer be any upstream cells, and backwater effects can be controlled through manipulation of the Cell 2 outflow gates.

STADG Comment	Response
How will the contractor install a 1-inch layer of lime sludge? Based upon prior results from lime sludge applications at the Flying Cow site, we recommend dropping the lime sludge/Riviera sand cell from the demonstration project.	We disagree. Lime sludge is the low-cost alternative source of calcium carbonate. Recent work at the FCRTF shows that a mat may be maintained with this substrate. Lime sludge may be installed using an agricultural spreader, similar to fertilizer or lime applications in fields.
Is the stated 50 ppb inflow concentration to the PSTA cells a maximum value, flow-weighted mean, geometric mean, or other? Can the desired PSTA community be established at inflow concentrations of 50 ppb, or will filamentous green algae become the dominant algal community	The 50 ppb inflow concentration is a maximum flow-weighted mean value that we expect to observe based on the early performance of STA-1E and other online STAs. Geometric means should not be used under any circumstances. PSTA communities were successfully developed at the FCRTF with inflow concentrations exceeding 100 ppb.
The team should consider moving the demonstration cells to Cell 2 so that the area of Cell 4S can be used to maintain STA operations. Cell 2 is smaller and construction of the demonstration project in this location will maximize use of the remaining site.	Agreed. Current plans are to locate the demonstration test plot in Cell 2.
The periphyton screen concept needs to be refined. A solid baffle or skimmer would be more effective than the mesh screen shown in the plans	Agreed. The use of a skimmer or limestone barrier will be further evaluated for Cell 2.
The DMSTA output contained in the document does not show the project achieving 10 ppb. What is the basis for the proposed operating conditions if the modeling projections do not indicate that the design will meet expectations?	The DMSTA does show a scenario at which 10 ppb was achieved.
Existing PSTA research has shown that even with 2 feet of limerock fill over existing soils, emergent macrophytes will colonize. This is especially true when the PSTA cells are situated next to emergent macrophyte cells and can receive seed stock via wind distribution or through surface water inputs. The team needs to develop a macrophyte management plan prior to construction.	It is expected that emergent vegetation will colonize the PSTA cells, thereby increasing the surface area for periphyton growth; thus, treatment efficiencies are expected to improve. In addition, this helps stabilize floating periphyton mats.
How will the site be dewatered to "activate" the periphyton? A slight positive slope between the inlet and outlet may be necessary for cell drainage.	Agreed. Cell drainage and groundwater seepage (inflow or outflow) will be further evaluated for Cell 2 to show that dewatering is possible.
Comments from Gary Goforth	
As we have stated from the outset of this project, it is critical that the construction and operation of the demo project minimize disruption of operation of STA-1E. As a demonstration project of a full-scale PSTA project, it needs to be designed to operate consistent with the anticipated operational regime of the STA, and the flow-way in which it resides. The correct period of record needs to be used – the simulated 1965-95 daily inflows to STA-1E were provided to Peter B. in April, and have been available on the District's website (Basin-Specific Feasibility Studies) for almost three years. Design provisions need to accommodate any operational requirements of PSTA that may be inconsistent with the adjacent vegetation communities in the STAs, For example, if dryout is required and the demo project is to be located in Cell 4S, then additional features (e.g., levees and pumps) may be needed to hydraulically isolate the PSTA demo project from the surrounding 452 acres of SAV in Cell 4S.	Current plans are to locate the demonstration test plot in Cell 2. Cell drainage and groundwater seepage (inflow or outflow) will be further evaluated for Cell 2 to show that dewatering (dry out) is possible.
We have suggested that the demo project be moved from Cell 4S in order to minimize adverse impact on operations (including start-up operations) of central flow-path and minimize impact from S-361 seepage pump. During the review meeting, there was good agreement from the external reviewers (including Dr. Jones) that the demo project should be moved to Cell 2.	Agreed. Current plans are to locate the demonstration test plot in Cell 2.
It appears the success of the demo is contingent on a healthy SAV community upstream, yet the DAR ignores this critical aspect. What activities are the Contractor/Corps planning in order to accelerate this grow-in? What is estimated length of time to establish SAV community in the upstream area?	Current plans are to locate the demonstration test plot in Cell 2 with a minimal SAV community that is expected to have negligible treatment capability. The EAV community upstream of the demonstration test plots will be established prior to the beginning of the project and is the more important pretreatment component. Work on establishing the EAV community has already begun. An Operations Plan for Cells 1 and 2 is being prepared as part of this effort.
What is current demonstration project schedule – construction, start-up, operation, full-scale design, construction and operation?	Due to delays caused by the move of this facility to Cell 2, the project schedule is being modified.

STADG Comment	Response
Page 5 of DAR – STA-1E is also being implemented under the Everglades Settlement Agreement (modified) and 1996 WRDA – and not just the Everglades Forever Act.	Agreed. Text will be revised to list these.
Suggest a full-flow demonstration project and not one with 24 different hydrologic scenarios, many of which appear to produce phosphorus concentrations well above the goal.	Short-duration tests with defined inflow rates will be conducted for only a short period of time to allow for correlation with pilot-scale experiments and for initial model calibration. The majority of the experiments will be conducted utilizing flows representative of full-scale operations.
During the review meeting, it was confirmed that the Contractor or Corps will operate the water control facilities during the operations and monitoring phase of the demonstration project.	Agreed. The contractor or ACOE will operate the Cell 1 and 2 water control facilities during the operations and monitoring phases of the demonstration project.
What outlet structures will be used for control of depth in the cells? 24 Stop log gates? No pumps?	Existing remotely controlled gates will control upstream inflow to Cell 1 and downstream outflow from Cell 2. Stop-log gates will be used to control flows/depths within the demonstration test plots. Current design efforts are directed toward Cell 2, with the assumption that the entire cell may be managed to provide the desired control of water levels within Cells 1 and 2.
If the project remains in Cell 4S, why not extend demo cells to the outlet structures since that is what is called for in full-scale implementation – and take advantage of outlet structures and S-362.	Agreed. See above comment.
Please provide all reports containing the data from Flying Cow Rd experiments. Peter said Dr. Jones says sampling is being conducted, but the Corps is having problems getting the data. Peter will have data available on the meeting on May 4th	Data will be provided when available.
Contractor should look at seepage/crosstalk between the cells and the surrounding treatment area.	Agreed. The effects of groundwater seepage inflow and outflow (crosstalk) should be further evaluated for Cell 2.
Marsh readiness of WTP lime sludge – deserves more attention – – 1 inch; much greater than what was applied at Flying Cow Rd facility – Peter will ask why – Peter will ask contractor to address marsh readiness	Agreed. Marsh readiness sampling issues were generated to address chemical treatment technologies. A minimal monitoring effort will be required to address marsh readiness issues.
Comments from Michael G. Waldon, Ph.D., P.E.	
The use of chemicals, including lime sludge and lime rock treatment presents some added concerns relative to currently applied “green” technologies for stormwater treatment. I have previously discussed this point with Corps staff and their contractor, and have on numerous occasions requested that impact of this PSTA treatment technology on calcium, alkalinity, and hardness be monitored. The refuge interior is a rainwater-dominated system (Gleason 1974; Richardson et al. 1990). It has long been noted that added dissolved minerals could shift the periphyton community in our interior away from the natural communities that form the base of our food chain (Browder et al. 1991; Browder et al. 1994). I am not requesting the full screening (termed marsh-ready tests) that was requested for other chemical treatment technologies, but we do need to monitor these parameters in the experimental cells before moving to this expanded design. We will also be requesting a significant level of monitoring of these parameters in the monitoring design for the field-scale test.	Agreed. Monitoring of calcium, alkalinity, and hardness will be addressed within the Monitoring Plan.

STADG Comment	Response
Groundwater discharge into the test cells may be significant (Brunke et al.1998; Choi and Harvey 2000; Krest and Harvey 2001; Krest and Harvey 2003). Seepage through the levees may be less important than flow under the levees that appears as seepage inside the cells. There is nothing I would suggest for this test that would reduce or eliminate this inflow and P loading (*e.g.* a pumped well, buried drain pipes, or seepage canal), but the effect of this discharge does need to be quantified as far as possible. Simple mass balance of conservative inorganic ions (e.g. Cl or Na) may be useful in such analyses. In STA-1W seepage meters have been used with varied success.	Agreed. The effects of groundwater seepage inflow and outflow (crosstalk) should be further evaluated for Cell 2. Use of alternative monitoring techniques for detecting seepage rates and water quality effects of seepage will also be further evaluated for Cell 2 within the Monitoring Plan.
Groundwater discharge within the cell may also reduce the efficiency with which P is permanently buried in the substrate. Advection of porewater into the surfacewater can carry significant amounts of dissolved P from the newly deposited sediments into the water column. Near-surface porewater in the sediments can have much greater P concentration than surface water, and this flow into the surface water column can thus have a disproportionately large influence on effluent concentration. I believe data from STA-1W and from refuge perimeter canals are consistent with this hypothesis (Daroub et al. 2002; Waldon and McCormick 2003).	This information will be covered in the Monitoring Plan. The STA1-W experience is a peat-based system; these issues should be monitored but are expected to be quite different.
I am concerned that taking borrow for levees and fill from other parts of the effective treatment area of the STA will reduce treatment effectiveness of the borrow area for treatment. Is it anticipated that the test cells will be deconstructed following the test and borrow areas refilled? If yes, is this a budgeted item?	Currently, demolition of the test cell levees is not planned and is therefore not included in the cost estimates for the demonstration test project.
As discussed in our meeting, the retention time equation (equation 1) used in the report to generate cumulative probabilities graphed in Figure 6 is derived for steady flow and is not appropriate for time-variable flow. One simple way to properly calculate retention times is to calculate velocity and integrate backwards in time to determine the length of time to traverse the cell (assuming plug-flow). This can be easily implemented on a spreadsheet. If this explanation is unclear, please feel free to contact me.	Noted. Retention times will be further evaluated during monitoring for the time-variable flow portion of this demonstration.
An additional possible misinterpretation of retention time distributions shown in Figure 6 is related to temporal rather than volumetric probability. The curve presented in the report shows the probability that on a given day a retention time will not be exceeded. A more relevant probability for some purposes is the probability that the retention time for a random volume of water traversing the treatment cell will not exceed a specified retention time.	Agreed. The percent of flow volume occurring at or below a given HRT is appropriate to consider, because the net phosphorus uptake will be calculated as a volume-weighted average. This frequency distribution will be presented in the Cell 2 analysis.
I am concerned that you may have problems obtaining gravity flow out of the test cells and drying the test cells when desired under the current design. I suggest that you consider completely isolating the eastern and western parts of Cell 4S by extending the eastern test cell levee from its southeastern corner to the discharge collection canal levee. Doing this would remove the problem of draining the test cells (or even getting gravity flow) when the SAV portion of Cell 4S is at too high of a stage. Alternatively, the test cells could be moved south so that their discharge would more directly enter the discharge channel through the S-369 structures.	Current design efforts are directed toward Cell 2, with the assumption that the entire cell may be managed to provide the desired control of water levels within the test cells.
Comments from Robert H. Kadlec	
Page 6. There is no reason to set the maximum depth (2.63 ft) in the PSTA cells according to the simulation results of another technology.	The maximum depth was based on the 10-year Period of Record flow-stage data provided by Burns and McDonald for the operation of Cell 4S.
Page 7. There is no reason to set the range of detention times in the PSTA cells according to the simulation results of another technology. Why would this range not be chosen based upon the results of the PSTA pilot project?	The range of detention times was based on the 10-year Period of Record flow-stage data provided by Burns and McDonald for the operation of Cell 4S.

STADG Comment	Response
The level-pool analysis shown in Appendix A is not suitable for the flow rates, geometry, depth and vegetation planned for the PSTA cells and the surrounding SAV bypass area. Head losses of 0.87 ft in PSTA and 1.67 ft in SAV are predicted for that 3.52 ft depth high-flow scenario. Head loss of 0.40 ft in PSTA is predicted for the six inch depth high-flow scenario. Overtopping of dikes is likely The hydraulic calculations need to be redone with due recognition of headloss.	The effects of head loss and vegetative flow resistance will be further evaluated for Cell 2 in the monitoring and operations phases of the project.
In general, it will not be possible to operate STA1E at fixed detention times, and consequently terminal PSTA cells will also not have controlled detention times. Pulse flow is the anticipated, design mode for the project. It seems critical to operate the demonstration project so that those pulses are present, and the expected full-scale operational mode is evaluated.	The majority of the demonstration will be conducted without controlled detention times. This concern will be further detailed in the Operations Plan.
The long-term average detention time for the entirety of STA1E is on the order of fourteen days. Various conceptual sketches have shown the full-scale STA1E PSTA to occupy 10 – 30% of the STA1E footprint. Indeed, the PSTA input concentration range of 20 – 30 ppb selected in this Draft Design will require something like 70% of the footprint. Therefore, an important benchmark is a PSTA with a detention time representative of 30% of the footprint. If that size is insufficient to reach the target of 10 ppb, then more land will be required to create a system large enough to reach the target. Conversely, if the 10 ppb target is reached with less than 30%, then a lesser fraction need be converted at fullscale. It would therefore seem that a five-day detention time should be the central focus. PSTA detention times of 14 and 21 days would mean huge increases in overall STA area, on the order of doubling the footprint.	Portions of the demonstration will be conducted with controlled detention times of 1 to 14 days, which will cover the recommended 5-day retention time. Portions of the demonstration will be conducted without controlled detention times. The retention time will be further evaluated for Cell 2 for time-variable flow for the portion of the demonstration conducted utilizing flows representative of full-scale operations.
The hydraulic analysis in Appendix A does not account for the inflow to cell 4S through S362. On an annual average basis, S362 adds 24 – 31% to the total other inflow to STA1E, and it all shows up in cell 4S. This very large addition to cell 4S inflows shows on Figure 2, but subsequently disappeared and is missing on Figure A1, and the analysis that goes with it.	N/A; this is no longer relevant to Cell 2.
There are 24 stoplog structures indicated on Figure 2, but only 21 are in the cost estimate.	Noted. The cost estimate for Cell 2 will be performed by the ACOE.
The bypass structure is apparently an (uncontrollable) box culvert. However sheet C-005 also shows a typical gate bypass structure.	N/A; this is no longer relevant to Cell 2.
There are no airboat/vehicular access facilities indicated.	The plans for Cell 2 will contain an airboat ramp and levees wide enough to be drivable.
The calcareous substrates planned for the study will have some significant phosphorus sorption capacity. Therefore, even in the absence of periphyton, these demonstration cells would be expected to remove phosphorus until the substrate becomes saturated. Consequently, it is necessary to know the EPCo and Kd parameters for the selected substrates.	This concern will be addressed within the section of the Monitoring Plan that addresses mass balance.
It is stated (page 16) that there are substrate thickness requirements for the periphyton biology. These are stated to be the native soil type (sand or peat), the amount of labile P in the native soils, and the P concentration in the underlying groundwater. Have any of these been measured, and if so, how were they used in setting the substrate thicknesses?	Limestone thickness was chosen due to experience at the FCRTF. The thickness of limesludge was chosen due to the tolerances of the application equipment and the need for full cover of the native soil.
What placement thickness tolerances are to be specified, especially vis-à-vis the one inch of lime sludge and two inches of special limerock?	Thicknesses of substrate will be specified as requirements.
What is the antecedent amount of labile phosphorus in the soils of cell 4S?	The facility is currently being designed for Cell 2. Phosphorus data are not currently available for Cell 2. Total phosphorus content of the soils will be measured in the future and will be detailed in the Monitoring Plan.

STADG Comment	Response
What are the amounts of agricultural chemicals in the soils of cell 4S? (Copper for example?)	The facility is currently being designed for Cell 2. Agricultural chemical data are not currently available for Cell 2. Information regarding gathering data on these constituents will be detailed in the Monitoring Plan
What leachates may be expected from the lime sludge, with reference to potential marsh-ready issues?	An analysis of the materials will be made available in the next revision of the design report (see end of this appendix).
Drawing C-001 states that the lime sludge is from Palm Beach. The cost table in Appendix C says it is from Broward County. Which is it?	The lime sludge will most likely be provided from Palm Beach.
The text (page 13) says the dikes have 3:1 side slopes; the cost table in appendix C says 2:1. Which is it?	All side slopes will be 3H:1V.
The six step PSTA startup protocol raises several questions: a. Do the two-week dry periods have to be at bone-dry conditions? Drainage will leave wet conditions, full dryout will be at the mercy of rainfall and ET.	The mat does not have to be bone dry. It is expected that the mat will be desiccated, semi saturated in some areas, and also with areas of minor pooling in depressions.
b. It is stated (correctly I think) that there will have to be water of appropriate quantity and quality from cell 4N. Consequently, the schedule for this project is unavoidably tied that for STA1E as a whole. Dry season startup for the PSTA cells is desirable, and possibly mandatory. The startup of the rest of STA1E will have been in progress for some small number of months, which may not provide water of adequate quality. If the STA1W startup is replicated, it could be eighteen months after flooding before appropriate water becomes available. The calendars for the parent and PSTA projects need to be compared, and contingency plans developed.	Agreed. Current plans are to locate the demonstration test plot in Cell 2. The EAV community upstream of the demonstration test plots will be established prior to the beginning of the project. Work on establishing the EAV community has already begun.
c. The adjacent portions of cell 4S are likely to be in SAV startup, and therefore at a fairly large depth. Gravity drainage will not be possible. With a 50 cfs pump, the cells would be emptied in about five days. No such pump is included.	Current plans are to locate the demonstration test plot in Cell 2. The effects of groundwater seepage (crosstalk) from adjacent portions of Cells 3 and 4N will be further evaluated for Cell 2 to verify whether drainage is possible.
d. Step 6, page 16, requires that dry down and reflooding be repeated as needed. What is the measure of whether such repetition is needed? The condition has been variously stated to be the development of "activated periphyton," or a "cyano bacteria dominated calcareous periphyton mat." What test will be performed to make such a determination, and at which locations?	This determination will be described in the Monitoring Plan.
e. It has been stated that too much phosphorus will cause the periphyton community to shift. The implication, and I believe it is correct, is that "activated" periphyton could deactivate if it was subjected to elevated P loadings or concentrations. In a full-scale setting, including this demonstration, there will be times of high flows and high phosphorus. How will this study determine the occurrence of deactivation, its probable return frequency, and the remedial action to be taken?	An established mat can withstand elevated phosphorus for a period of time. The Monitoring and Operations Plans will detail both how changes in mat composition will be monitored and how to control phosphorus loads.

STADG Comment	Response
The 4x6 full factorial test scenario cannot be executed in any meaningful way over the proposed 18-month test schedule. a. The mean time per test is three weeks, which is not enough to even flush the previous water for a 21-day detention time. b. The various substrates will have some non-negligible phosphorus retardation factor, which may mean a physical system flushing time of months just to re-equilibrate sorption phenomena. c. The ecological response time for the many precursor PSTA studies has been measured to be months, regardless of substrate type. A brief test (weeks) will not be representative of the long-term sustainable P removal capability of the system under study. d. For the reasons stated above, it is not possible to extract reliable design information from the tests as planned.	Agreed. A 4x6 full factorial test scenario was not planned. The majority of the experiments will be conducted without controlled detention times. This will be further detailed in the Operations Plan.
The PSTA project occupies a significant fraction (ca. 20%) of the flow width of STA1E, and therefore interacts operationally with the full STA1E. There are choices required. STA1E could accept all design flows, and endure the consequences (positive or negative, if any). Or, incoming flows could be altered so as to preserve one or more of the intended design operating conditions. No matter what is decided, it would seem to be necessary to include the choice in the design documents and obtain the necessary permit modifications.	Current plans are to locate the demonstration test plot in Cell 2, which should eliminate this concern.
How do you know the outlet periphyton barrier will in fact block its passage?	The use of alternate barriers, such as skimmers and limestone barriers, will be further evaluated for Cell 2.
I would first like to clear up a slight misunderstanding concerning the relation of the SFWMD PSTA results and those from the Flying Cow PSTA pilot project. The statement is made in the Scope of Work that "The results achieved by these pilot studies at STA-1E were significantly greater than other PSTA research where PSTA was only capable of removing phosphorus to 15 ppb." At Flying Cow, the protocol was to run the flumes until everything "looked good," and then take data for 78 days. The average concentrations out of the three flumes were 19.8, 10.2, and 9.4 ppb for channels 1,2, and 4 respectively. The k values for C* = 4 ppb were 9.9, 20.3 and 37.8 m/yr respectively. For comparison, we look at the SFWMD data for STC3 and STC8. As a fair comparison, we look at a three-month section of the five-year record, in which "things look good." STC 3 achieved 9.2 ppb; STC 8 achieved 9.7 ppb. The k values were 52 and 48 m/yr respectively. Over the past two years, the output of these two test cells has been 13 and 14 ppb respectively. It is clear that a more objective comparison of the two sets of results shows there is not much difference. There may, however, be a difference in terms of startup time. The issues then become cost and calendar.	Noted. This comment will be addressed in the monitoring, operations, and modeling aspects of this effort.
The DMSTA computations in the Draft Design Report do not seem to correspond to any basis data. The choice of one stirred tank is puzzling, since that would not correspond to other PSTA tracer tests. A rate constant appears to have been chosen on some basis other than the STA1E Flying Cow data. Therefore, the performance map (Figure 11) is of questionable value. If SAIC believes this forecast, then they believe the project will fail. There is no question that a model, DMSTA or something similar, will be of use to interpret data when it becomes available, and thereafter to do conceptual design calculations.	This project will develop a PSTA model that will work in conjunction with the DMSTA.

STADG Comment	Response
It is not clear how Figure 12 was developed, but I am assuming that the flow rate was varied to produce different detention times. There are two important points about such a graph. a. This is the response of a single well-mixed unit to varying flows. It has an asymptote of about 20 ppb in this figure. However, the model allows removal down to 4 ppb. The artificial plateau at 20 ppb is an artifact of the assumed degree of mixing. It is obviously critical to understand, via tracer studies, the degree of mixing in a pilot (not done), as well as in the demonstration project. b. The profile of Figure 12 is not the same as a transect down the cell, in which flow-weighted concentrations are measured.	Agreed. (a) The approach to monitoring of mixing achieved will be addressed in the Monitoring Plan. (b) The concentration over time under time-variable flow will be studied during the portion of the demonstration conducted utilizing flows representative of full-scale operations and variable retention times. Figure 12 depicts a steady-state condition.
The water quality transect studies in the work plan are of little value, because it is not possible to know where to sample across the 1000 foot width, or where in the depth profile, to get a sample that represents the cross-section of flow.	Disagree. The Monitoring Plan will describe the locations, depths, and frequencies of sampling to define the variability in conditions across the width of each test cell.
The mass balances alluded to in the Draft Design Report are indeed critical to understanding and design. They will rest in major proportion upon the water mass balance for the PSTA cells. Rainfall can be measured, and ET estimated, probably to an acceptable level of accuracy. a. It is recommended that recession curves be measured for each cell, to confirm or deny the estimated seepage. b. Inflows will occur at four points in each cell, and outflows also at four. Error compounding is extremely likely in such a case, and calibration of each structure becomes critical. The proposed weir structure design (sometimes submerged, sometimes free-fall) is such that calibration is not easy. Regardless, accurate structure rating curves, together with accurate and continuous head water and tail water monitoring will be required to obtain reasonable accuracy in the water mass balance. c. Given numerous bad experiences with stop log structures elsewhere in the Everglades protection projects, and the high level of manual attention demanded by the intended operation of the three PSTA cells, it would be prudent to revisit the selection of structures. A refocus on operations and flow calibration is recommended.	Agreed. (a) Measurement of recession (drainage) of each cell will be described in the Monitoring Plan. (b) Measurement of water height at the stop-log control structures, head water, and tail water will be described in the Monitoring Plan. (c) The stop-log structures are considered acceptable for temporary test conditions.
The schedule in the Work Plan does not contain any non-Corps review of either the Monitoring Plan or the Operations Plan, such as the current efforts for the Draft Design Report. There are numerous early warning signs that either or both of those plans could benefit from external review. I list a few: a. The Work Plan states that it (Monitoring Plan, Task 6) "…will provide the information on the water treatment efficacy of emergent growth with in Cell 3, SAV within cell 4N and with extensive emphasis on periphyton in Cell 4S." It seems rather ambitious to investigate the entire flow train, especially since that job has clearly been assumed by others under the Long Term Plan.	Reviews are now built into the contractor's Statement of Work.
b. The Work Plan states that it (Monitoring Plan, Task 6) will include: "…estimation of annual marl formation." Since no other PSTA researcher has yet found a way to that, it will be of interest to see what is proposed.	The length of demonstration may not allow for significant marl deposition. However, lime rock tiles or concrete pads will be placed within the cells to determine if significant accumulation has occurred.
The schedule of data acquisition in the Work Plan has been shortened from eighteen months (as of September 2003) to 12 months (current Work Plan). What is the justification for this, other than a desire to meet a 2006 deadline? One year of data acquisition is just barely enough for one treatment scenario, not 24. It is not obvious how that amount of data can be an adequate scientific basis for the expenditure of many millions of dollars	The majority of the demonstration will be conducted utilizing dynamic flows proportional to the width of the treatment area, based on the period of record. However, this can be accomplished only if sufficient treatment occurs within Cell 1 to attain 50 ppb.

STADG Comment	Response
The later portions of the time schedule in the Work Plan is predicated on the most successful outcome that could be imagined, namely, that PSTA can get to 10 ppb while consuming only a small fraction of the current footprint of the entire STA. There is currently no scientific basis for that presumption. While it may be hoped that this optimistic outcome will occur, it is more probable that expansion of the STA1E footprint would be required, if indeed the demonstration can be coaxed to 10 ppb. If repeated "reactivation" is needed, that too will lead to more STA area.	Noted. The demonstration will test variable inflows and depths to provide experimental data as a basis for forecasting long-term performance. This project will then develop a PSTA model that will work in conjunction with the DMSTA for forecasting long-term performance. Implications on the STA-1E footprint cannot be reasonably inferred at this time.
With reference to the Burns and McDonnell study cited by SAIC, I find that they estimated the transmission coefficient of the levees as 111E-6 cfs/ft2. This is to be contrasted to the SAIC estimate of 0.033E-6 cfs/ft2. The difference is a factor of 3,400. If the Burns & McDonnell estimate is correct, bank losses may compromise low flow water budgets.	Seepage through the levees has been shown not to be significant. The effects of groundwater seepage (crosstalk) from adjacent portions of Cells 3 and 4N will be further evaluated for Cell 2.
During the meeting on May 4, Dr. Jones informed us that there were pilot project reports that covered data collections after June 6, 2003. Stakeholders have been provided with two brief undated reports entitled "Experimental Regime #1" and "Experimental Regime #2", which cover two periods during March 20, 2003 to June 6, 2003; totaling about eleven weeks. I would like to be able to read those reports, because Dr. Jones indicated to us at the May 4 meeting that, after June 6, 2003, the periphyton community "shifted" and performance was no longer acceptable. Dr. Jones indicated to us that it has been necessary to start over, and go through another period of activation for the periphyton. Please forward all such reports and data. It is critically important to the design of the field scale project to understand the probable cause of this failure after such a short operational period of success. For instance, if four months are needed to "activate", and there ensues only a four month period of acceptable operation, there are grave consequences for full-scale implementation.	Data reports will be provided once they are available. The comments of Dr. Jones were misinterpreted.
The Flying Cow pilot results for lime sludge application were disappointingly poor, according to the two reports in hand, and as acknowledged by Dr. Jones at the May 4 meeting. That may or may not have been due to inadequate amounts of sludge application in the pilot. However, it would seem prudent to test larger amounts of lime sludge in the pilot, before embarking on a possibly fruitless hundred-acre experiment.	Disagree. The FCRTF data provided useful information, and it is our understanding that Portland State University will be evaluating the proposed 1 in. lime sludge application.
I was disappointed to learn that the field scale demonstration would not be applicable to soil types other than sand, especially not to peat soils. That restriction will mean that, even if the demo project is successful past all expectations, it will not be applicable to more than a fraction of STA-1E.	Disagree, as the demonstration project was not designed to be applicable to all STAs. The suggested substrates will be applicable to the entirety of STA-1E.
During the May 4 meeting, it was stated that transect measurements in the flow direction could serve as a surrogate for detention time variations for the full demo test wetland cell. That is a theoretically incorrect presumption. The project personnel should consult the literature on non-ideal flow patterns in wetlands and other reactive flow situations, with respect to mixing-cup versus through-the-wall measurements. Additionally, there is no known method to obtain an accurate sampling across a thousand-foot width.	Disagree. The Monitoring Plan will describe the locations, depths, and frequencies of sampling to define the variability in conditions across the width of each test cell.

JEFFRE004356
Jeffrey Rhodes
Jeffrey Rhodes
2120 Collins Court
Hollywood, FL 33020

Page 3
June 30, 2004
Submission # 406000834
Order # 49124
FDEP CompQAP# 990102
FL-DOH Certification# E86349,E86616

Site Location/Project
Loxahatchee, FL
C-51 Periphyton Facility

Sample I.D.: Broward Line
Collected: 06/16/04 12:00
Received: 06/16/04 15:49
Collected by: Client

PARAMETER	RESULT	UNITS	METHOD	DETECTION LIMIT-RQL	DATE EXT.	DATE ANALY.	ANALYST
Percent Solids	96.9	%	160.3	0.10	06/24/2004	06/24/2004	JJT
Phosphorus, Total as "P"	106	mg/Kg	365.4	20.0	06/24/2004	06/24/2004	DSR
Calcium Soils By ICP	253000	mg/Kg	3050/6010B	1.0	06/16/2004	06/19/2004	SB
Silicon	30	mg/Kg	6010B	1.0	06/23/2004	06/27/2004	E87052

BDL: Indicates Analyte is Below Detection LimitMEDF: Matrix Effect Dilution Factor***
Work Subcontracted to Outside Labs Denoted by HRS Cert ID in Analyst Field
Qualifier following result conforms to FAC 62-160 Table 7****Unless otherwise noted, mg/Kg denotes wet weight***
***62-770: If the MDL using the most sensitive and currently available technology is higher than a specific criterion, the PQL shall be used.
Certs:FL=E86349, AL=41180,CT=PH0217, MD.=#271, MA.=#M-FL535,PR=FL00535 SC=96023,TN=TN02836
*Tests results meet all the requirements of NELAC, unless identified as "certification in-process" coded by (01).Tests coded (02) we are not currently seeking certification by NELAC for.
For any inquiries,please contact the representative who signed this report, or the QA department.

Cynthia Patterson - Burch
Project Manager / Dep. Organics Tech. Dir

JEFFRE004356
Jeffrey Rhodes
Jeffrey Rhodes
2120 Collins Court
Hollywood, FL 33020

Page 4
June 30, 2004
Submission # 406000834
Order # 49125
FDEP CompQAP# 990102
FL-DOH Certification# E86349,E86616

Site Location/Project
Loxahatchee, FL
C-51 Periphyton Facility

Sample I.D.: WPB Line
Collected: 06/16/04 12:00
Received: 06/16/04 15:49
Collected by: Client

PARAMETER	RESULT	UNITS	METHOD	DETECTION LIMIT-RQL	DATE EXT.	DATE ANALY.	ANALYST
Percent Solids	29.8	%	160.3	0.10	06/24/2004	06/24/2004	JJT
Phosphorus, Total as "P"	24.4	mg/Kg	365.4	20.0	06/24/2004	06/24/2004	DSR
Calcium Soils By ICP	92000	mg/Kg	3050/6010B	1.0	06/16/2004	06/19/2004	SB
Silicon	33	mg/Kg	6010B	1.0	06/23/2004	06/27/2004	E87052

BDL: Indicates Analyte is Below Detection LimitMEDF: Matrix Effect Dilution Factor***
Work Subcontracted to Outside Labs Denoted by HRS Cert ID in Analyst Field
Qualifier following result conforms to FAC 62-160 Table 7****Unless otherwise noted, mg/Kg denotes wet weight***
***62-770: If the MDL using the most sensitive and currently available technology is higher than a specific criterion, the PQL shall be used.
Certs:FL=E86349, AL=41180,CT=PH0217, MD.=#271, MA. =#M-FL535,PR=FL00535 SC=96023,TN=TN02836
*Tests results meet all the requirements of NELAC, unless identified as "certification in-process" coded by (01).Tests coded (02) we are not currently seeking certification by NELAC for.
For any inquiries,please contact the representative who signed this report, or the QA department.

Cynthia Patterson - Bruce
Project Manager / Dep. Organics Tech. Dir

APPENDIX E
RATIONALE FOR UTILIZATION OF FLOATING AQUATIC VEGETATION IN STA-1E

IMPROVING STA-1E WATER QUALITY WITH FLOATING AQUATIC VEGETATION

INTRODUCTION

Total Phosphorus (TP) in the source waters for STA-1E exceeds the TP concentrations entering all other STAs with exception of STA-5. The poor performance of STA-5 relative to desired outflow concentrations tempers the expectations for achieving desired effluent phosphorus concentrations from Cell-1 of STA-1E of 50 ppb TP. To increase the probability of achieving 50 ppb at the output of Cell-1 additional technologies need to be evaluated. Floating Aquatic Vegetation (FAV) is being used in Central Florida to treat the high phosphorus concentration water associated with L-62 canal and should be evaluated within STA-1E. Improvements in Cell 1 concentration outflows are also needed to conduct a PSTA Demonstration Test with inflow TP concentrations representative of the intended STA-1E treatment. Finally, FAV can potentially benefit the water quality performance of the remainder of STA-1E and possibly STA-5.

CURRENT CONDITIONS

Recent water quality data from the STA-1E's input structure shows a mean phosphorus concentration of 214 ppb (**Figure E-1**). This is higher than anticipated when the STA-1E was designed and, as mentioned above, higher than TP inflow concentrations in all other STAs, except for STA-5. Such high inflow concentrations will result in STA-1E outflow concentrations being higher then intended. In addition, PSTA technology, that is to be evaluated in STA-1E to reduce total phosphorus to levels below 10 ppb, is not considered sustainable at concentrations significantly above 30 ppb. The PSTA Demonstration Facility as currently designed will be located within Cell 2 of STA-1E and the treatment train preceding it

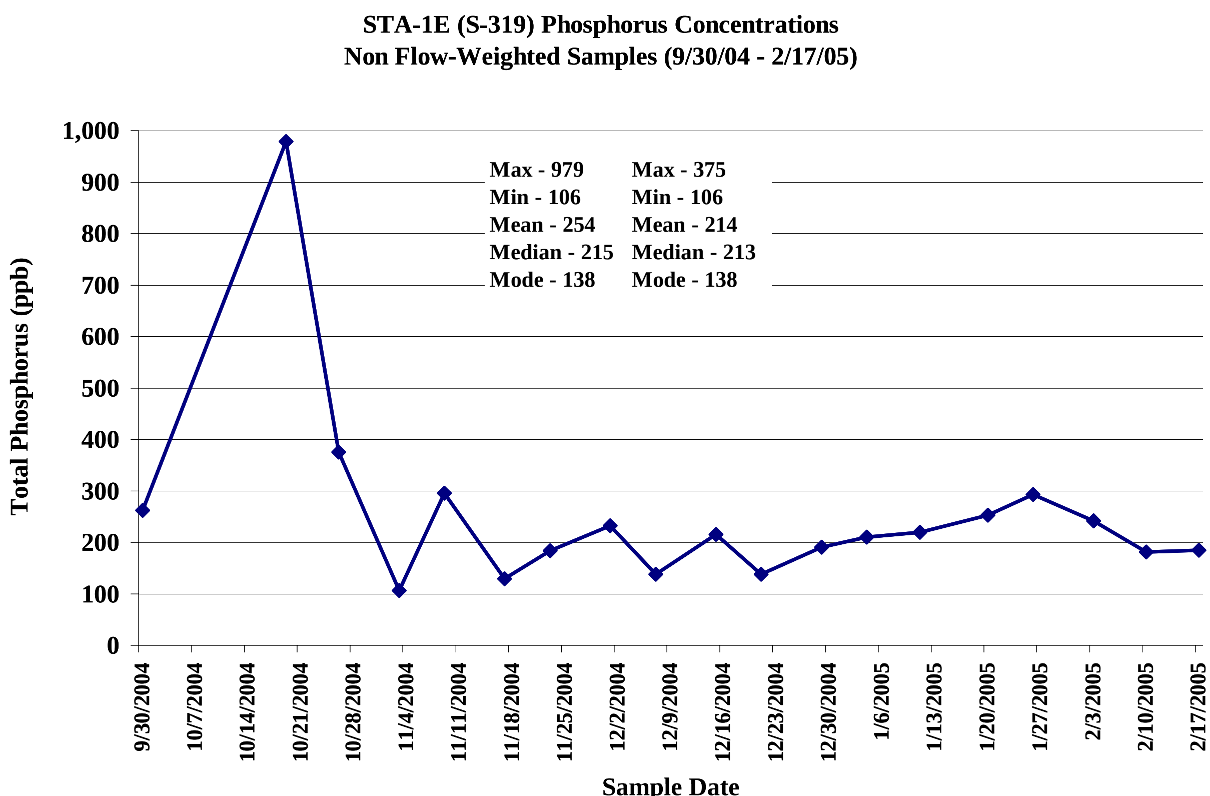


Figure E-1. STA-1E Input (S-319) Phosphorus Concentrations. Note: Secondary statistical summary considers the 979 ppb value as an outlier.

will consist of an existing 387-acre open water Distribution Cell followed by an existing 515-acre EAV cell (Cell 1) and a newly constructed 55 acre SAV cell in Cell 2. DMSTA modeling of the existing treatment train preceding the PSTA Demonstration Facility was completed taking full credit for the 515 acres of EAV in Cell 1, but no treatment in the EDC. The DMSTA model runs showed that phosphorus concentrations exiting Cell 1 exceeded the targeted 30 ppb of TP, with values of up to ~80 ppb at required maximum test flows of 55.32 cfs (see **Figure E-2** below).

Clearly, the current water quality situation in STA-1E needs to be improved for both the STA wide performance and the PSTA Demonstration.

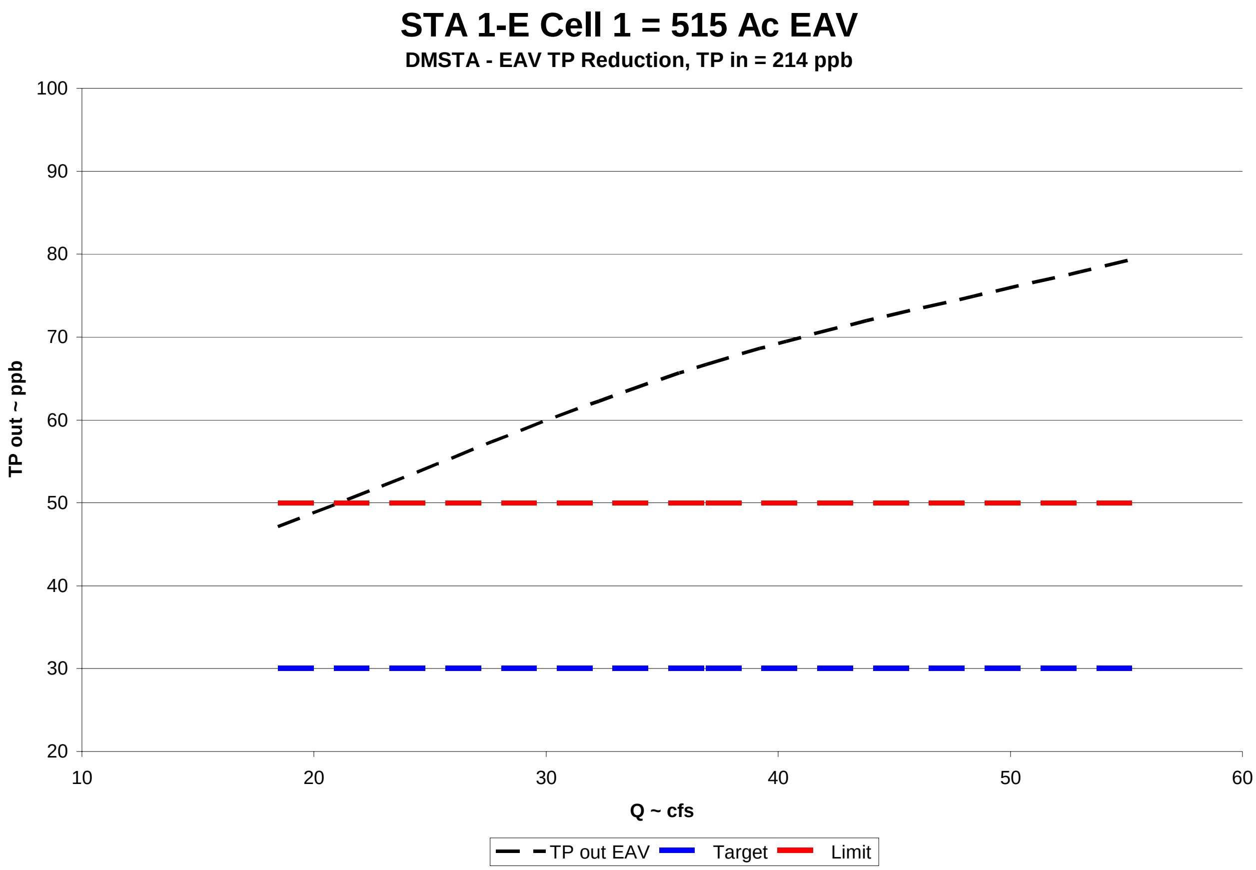


Figure E-2. Projected Phosphorus Concentrations Entering PSTA Demonstration Facility as currently configured.

SOLUTION

Adding FAV to the STA-1E Distribution Cell should significantly attenuate the high phosphorus concentrations expected in the influent to all of the STA cells. FAV effectiveness can be tested by planting it in the eastern Distribution Cell to treat waters needed for the PSTA Demonstration.

FAV water treatment systems are an established technology for tertiary waste water treatment and high-density animal husbandry operations in warmer climates. The objective of these systems is to reduce nutrients (phosphorus and nitrogen), suspended solids and phytoplankton from the water column. Several species of plants have been used within FAV systems, including *Eichornia crassipes, Pistia stratoides,* *Lemna sp*., and *Hydrocotyle umbellate*. *Eichornia crassipes*, (water hyacinth) is the most widely used of these species.

Phosphorus removal mechanisms within FAV systems include:
1. The direct uptake of phosphorus and nitrogen for plant growth.
2. Removal of biomass along with the incorporated phosphorus and nitrogen by harvesting. Although this is the most efficient mechanism for phosphorus and nitrogen removal, it is also the most time consuming and expensive. Therefore, it is not anticipated that biomass removal will be conducted in STA-1E.
3. Decay of the herbaceous material with subsequent settling and sequestering of this material and the incorporated phosphorus and nitrogen into the sediment.
4. The physiochemical process of flocculation of phosphorus and nitrogen due to the tortuous path and slow water velocities caused by the root mass hanging in the water column. It is anticipated that this will be the long term removal mechanism in a passive FAV system similar to that proposed for STA-1E.

It will be necessary to inoculate the FAV cell with the appropriate species. The factors effecting this inoculation will vary with the area, nutrient concentrations (TP and TN), season (temperature, photosynthetic active radiation, rainfall) and the species to be planted. It is anticipated that water hyacinths will be used and that 20% of the total area will be inoculated with a 6 to 9 month grow-in period required for optimal coverage (>80%). It may be possible to inoculate a smaller percentage of the area (5%) depending on the inoculation season and/or by increasing the grow-in period.

COMPARABLE PROJECTS

Water hyacinths have been used in south/central Florida as a component of a phosphorus removal system in both pilot- and field-scale demonstrations. These demonstrations are useful in projecting the performance of water hyacinths within STA-1E:

Village of Wellington – This treatment system had two parallel aquatic vegetation treatment trains, one of which included an in-series system of FAV, EAV, and then PSTA. Water hyacinths were grown in a 450 square foot FAV cell that was operated at a depth of 3 feet. The demonstration project was conducted for two years from 2001 to 2003. Upon completion of the study the facilities were demolished and the site was returned to pre-study conditions. This project was completed by the Village of Wellington with matching funds from the State of Florida, FDEP Agreement No. WAP019. The high flow period flow velocity was 39.3 cm/day, and the low flow period velocity was 33.1 cm/day. The cell was stocked to 80% coverage, then allowed to grow, followed by monthly harvesting. In addition to tracking concentrations, the mass removals of each treatment cell were calculated and reported. Exceptional mass removals for the FAV were reported at 95% for high flow conditions and 79% for low flow conditions. The reported settling rates were also excellent.

S-154 Prototype ATS™ - WHS™ Aquatic Plant Treatment System – This water treatment system utilizes water hyacinths as the first stage of a two stage treatment train. Water hyacinths are grown within 2-1.25 acre cells that are operated at four foot water depth. The project is located north of Lake Okeechobee and is part of the Phosphorus Source Grant Program. Effective Velocity (K_e) of 108 m/yr for Water Hyacinth Scrubber (WHS™) was calculated by HydroMentia per the methodology developed by Walker [Walker, W.W. 1995 "Design Basis for Everglades Stormwater Treatment Area" *Water Resources Bulletin, American Water Resources Association* **Vol, 31 No.4**], based upon the WHS™ average areal total phosphorus removal rate of 23.74 g/m^2-yr documented as part of the South Florida Water Management District Contract C-

13933 [S-154 Pilot ATS™-WHS™ Aquatic Plant Treatment System. Final Report, 2005]. WHS™ performance was associated with cultivated water hyacinth crop sustained through harvesting, with an average net specific growth rate of 0.0093/day or a mean plant age of 107 days over six continuous quarters of operation. Such performance levels cannot be expected over a long term without a sustainable operational strategy, to include periodic and frequent harvesting of a portion of the standing crop.

Everglades Nutrient Removal Project (ENR) – The ENR was a prototype Everglades STA that was operated from 1995-1999. The first cell within the treatment system was a 133-acre buffer cell which was operated at an average water depth of 1.9 feet and was allowed to naturally vegetate. November 1998 overflight data showed the vegetation within the Buffer Cell to be 51% emergent vegetation and 41% FAV. This portion of the STA was its highest performing removing 8.30 g P/m2/yr. **Figure E-3** shows the ENR three-month TP average settling rate.

Table E-1. FAV Project Performance Summary Table

Project	Influent TP ppb	Settling Rate (m/yr)
Wellington	High flow: 446 Low flow: 136 POR: 332	High flow: 215 Low flow: 102 Average: 169
S-154 WHS	279	High flow: 123.5 Average: 108
ENR	106	Highly variable (see **Figure E-3**) High flow: (10/1995–1/1996) – 111 (ACOE 1997 Low flow: (10/1996–3/1997) – 149 (ACOE 1997)

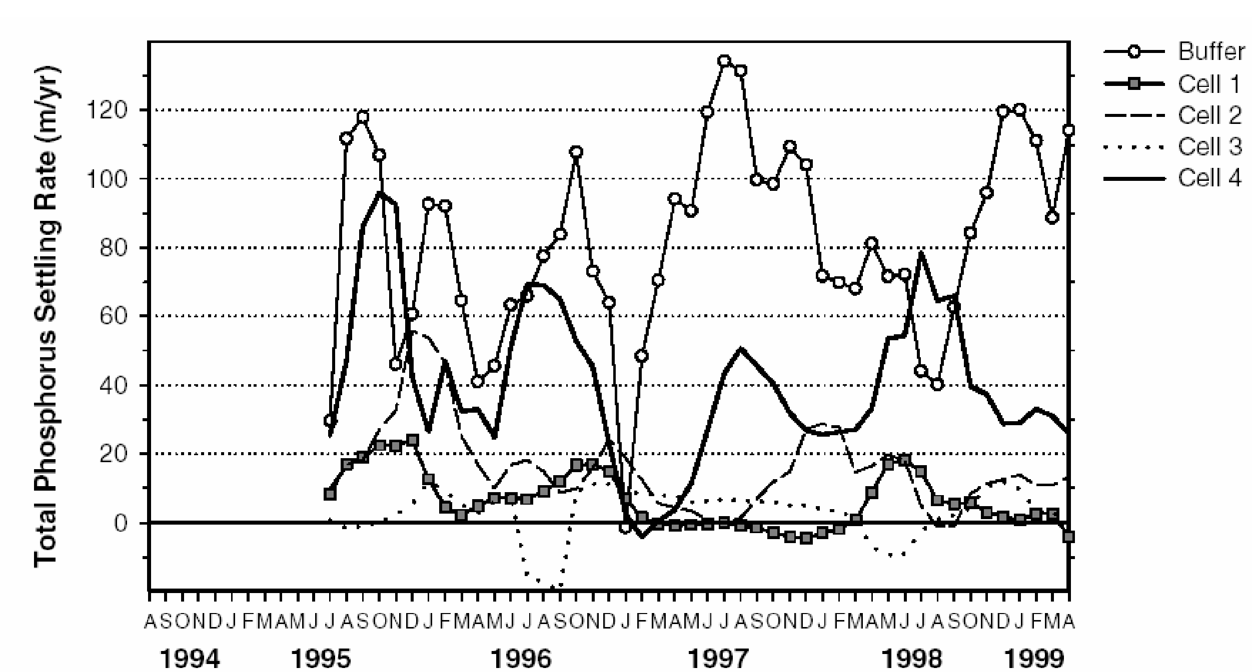


Figure E-3. Three-Month Rolling Average Total Phosphorus Settling Rate for Everglades Nutrient Removal Project from July 1995 – April 1999 (Figure Source 2000 Everglades Consolidated Report)

ANTICIPATED FAV PERFORMANCE IN STA-1E EAST DISTRIBUTION CELL

Figure E-4 illustrates the output from the DMSTA model for STA-1E Cell 1 containing 515 acres of effective EAV plus 50 acres of effective SAV in Cell 2 and an additional 70 acre effective area of FAV upstream of Cell 1 in the East Distribution Cell. FAV is very effective at the removal of TP from high concentrations down to about 50 ppb. The settling rates are similar to SAV. The aforementioned limits of 50 ppb for FAV and 30 ppb for EAV are built into these model results to more properly depict the limits of their respective treatment abilities. The required treatment areas were defined by the 55.32 cfs required for the PSTA test and the 214 ppb TP inflow concentration into Cell 1. The DMSTA model was utilized to establish that a 70 acre effective FAV area had to be added to the 515 acre EAV and 50 acre SAV to meet the required test conditions of 55.32 cfs and 30 ppb TP inflows into the PSTA Test Cells with 214 ppb TP Cell 1 inflow. Results for all other lesser test flow conditions are below the required 30 ppb into the PSTA Test Cells. This configuration thus successfully meets the required inflow concentration of 30 ppb for all three PSTA Test Cells, and provides a viable test of FAV for STA-1E.

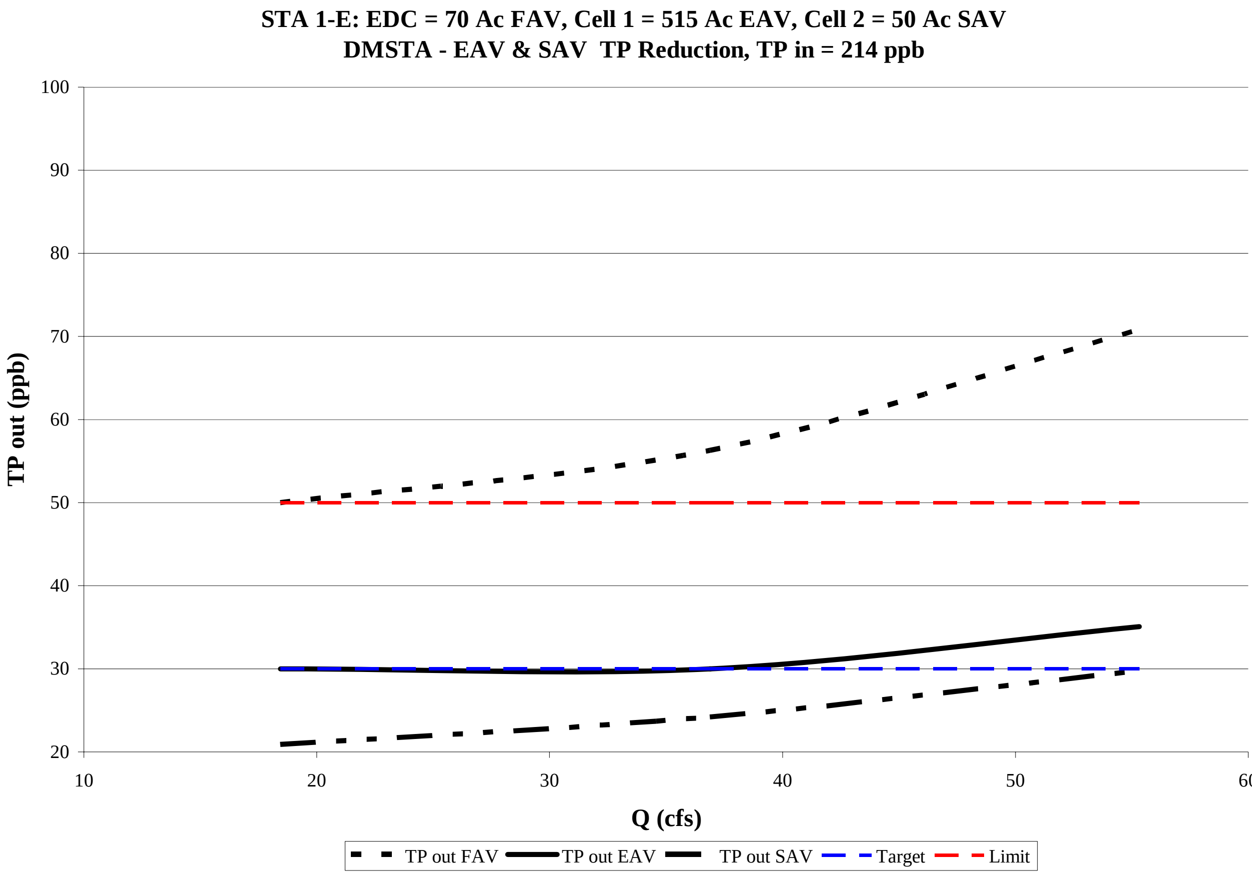


Figure E-4. Projected Phosphorus Concentrations Entering PSTA Demonstration Facility with Treatment Train Modifications

SUMMARY

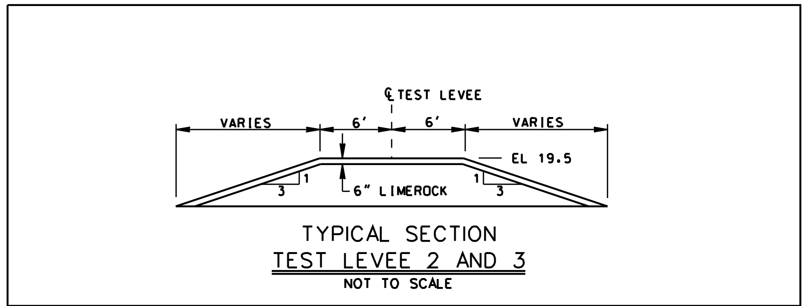
- Advantages: The advantage of FAV lies primarily in the ability of these communities to sequester TP at very high concentrations (150 ppb and above) with a very high settling rate compared to EAV. The plants require little maintenance and once grow-out is complete the mechanism of TP removal will vary only slightly with season, because the primary mechanism of removal is physiochemical.
- Disadvantages: Water hyacinths are an exotic invasive species. FAV has not been modeled using DMSTA. Since FAV is susceptible to movement with wind and currents the FAV must be contained with physical barriers.
- Conclusion: FAV shows great potential to achieve the STA-1E water quality goals and allows for the PSTA treatment train to accept higher wet season flows than the current conditions. It is the low cost solution that minimizes modification of current STA design. Implementation could provide STA-wide benefits in the long-term.

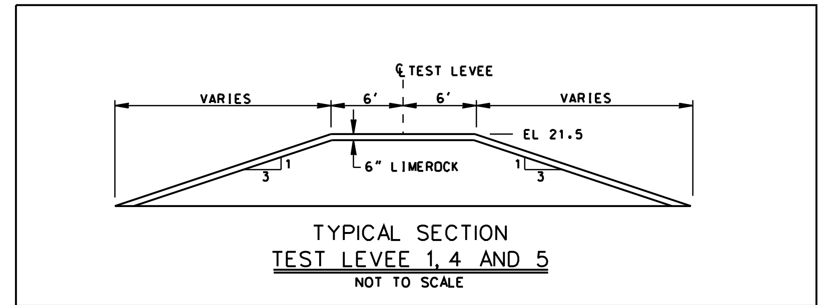
REFERENCES

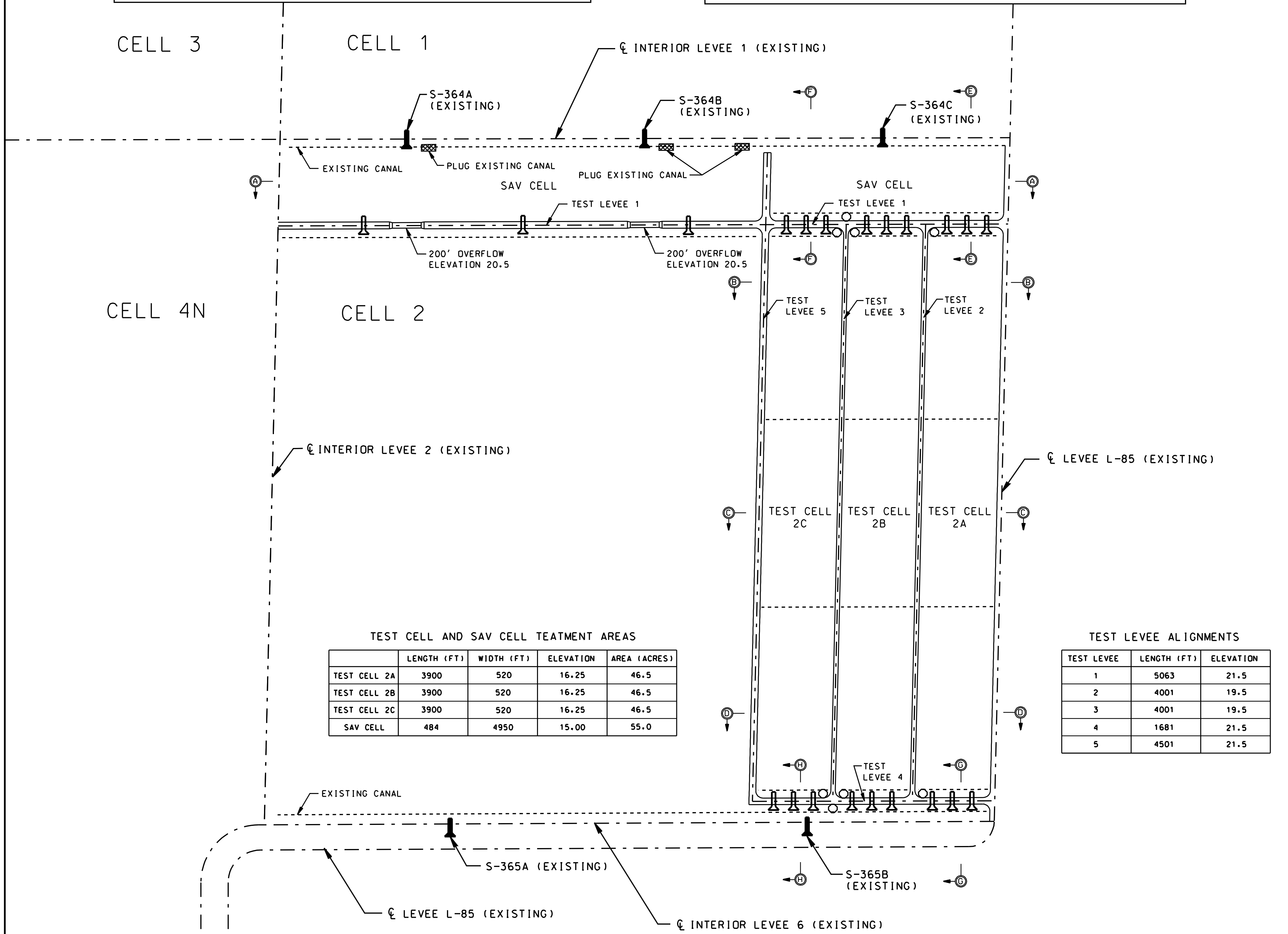
USACE, 1997. *Stormwater Treatment Area 1-East*, *Conceptual Design Review and Recommendations.*

SFWMD, 2000. *Everglades Consolidated Report 2000*.

APPENDIX F
PRELIMINARY DESIGN DRAWINGS





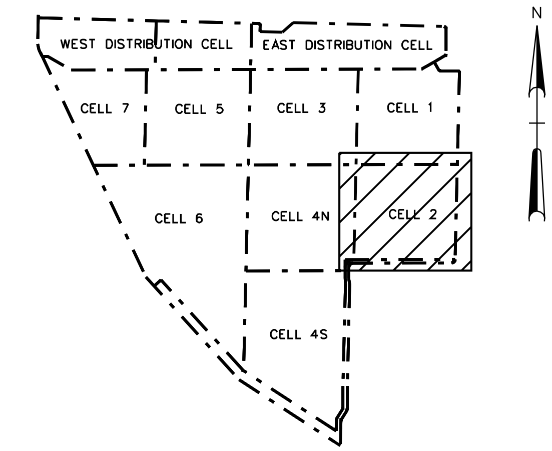


TEST CELL AND SAV CELL TEATMENT AREAS

	LENGTH (FT)	WIDTH (FT)	ELEVATION	AREA (ACRES)
TEST CELL 2A	3900	520	16.25	46.5
TEST CELL 2B	3900	520	16.25	46.5
TEST CELL 2C	3900	520	16.25	46.5
SAV CELL	484	4950	15.00	55.0

TEST LEVEE ALIGNMENTS

TEST LEVEE	LENGTH (FT)	ELEVATION
1	5063	21.5
2	4001	19.5
3	4001	19.5
4	1681	21.5
5	4501	21.5



LOCATION

LEVEE FOOTPRINT
LEVEE CENTERLINE
COLLECTION/SPREADER CANAL
GATED BOX CULVERT
IN LINE FLASHBOARD PIPE AND RISER
PVC STILLING WELL

LEGEND

GENERAL NOTES:

1. ELEVATIONS ARE IN FEET AND ARE REFERENCED TO THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29).
2. CLEAR ALL EXISTING VEGETATION FROM PROPOSED WORK AREAS.
3. EXCAVATE SAV CELL TO ELEVATION 15.0. MATERIAL TO BE USED FOR LEVEE AND TEST CELL CONSTRUCTION.
4. EXCAVATE 5' WIDE COLLECTION/SPREADER CANALS TO ELEVATION 12.0 WITH 3H:1V SIDE SLOPES WHERE SHOWN. MATERIAL TO BE USED FOR LEVEE CONSTRUCTION.
5. REFER TO PLATES W202 AND W203 FOR TYPICAL SECTIONS.
6. REFER TO PLATE W203 FOR PVC STILLING WELL, IN LINE FLASHBOARD PIPE AND RISER, AND TEST CELL SUBSTRATE DETAILS.

TEST LEVEE NOTES:

1. INSTALL TWELVE (12) 36" DIAMETER, 70' LENGTH CMP CULVERTS WITH 48" DIAMETER, 9.5' HEIGHT FLASHBOARD RISERS INTO TEST LEVEE 1 PLACED AT INVERT ELEVATION 12.0.
2. INSTALL NINE (9) 36" DIAMETER, 70' LENGTH CMP CULVERTS WITH 48" DIAMETER, 9.5' HEIGHT FLASHBOARD RISERS INTO TEST LEVEE 4 PLACED AT INVERT ELEVATION 12.0.
3. PLACE A MINIMUM 6" OF ON-SITE LIMEROCK TO FINISHED GRADE ON ALL TEST LEVEES.

TEST CELL NOTES:

1. GRADE TEST CELL 2A TO ELEVATION 16.25 +/- 1.5" FOLLOWED BY THE SPREADING OF AN AVERAGE 1" DEPTH OF LIME SLUDGE HAULED FROM OFF-SITE.
2. GRADE TEST CELLS 2B AND 2C TO ELEVATION 15.75.
3. PLACE A MINIMUM 4" OF ON-SITE LIMEROCK FOLLOWED BY A MINIMUM 2" OF OFF-SITE LIMEROCK TO ELEVATION 16.25 +/- 1.5" IN TEST CELL 2B.
4. PLACE A MINIMUM 6" OF ON-SITE LIMEROCK TO ELEVATION 16.25 +/- 1.5" IN TEST CELL 2C.

GRAPHIC SCALES
300' 0 300' 600'

PRELIMINARY
NOT FOR CONSTRUCTION

US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

D.O.FILE NO. 400-38, 481
Dated: FEB 2005

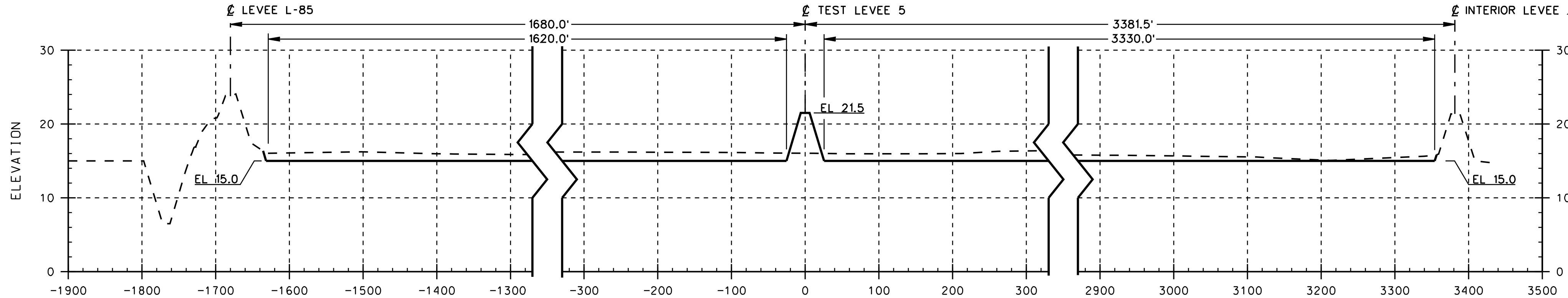
Designed by:
Dwn by:
Ckd by:

File name: STA1E-PSTA_ALT1B.DGN
Reference files: STA1E-PSTA_BRDR_B.DGN

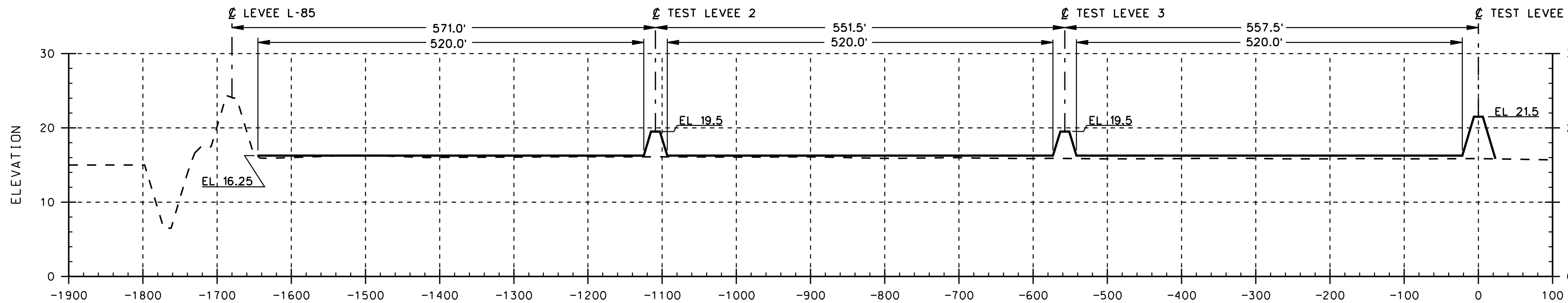
CENTRAL AND SOUTHERN FLORIDA PROJECTS
FOR FLOOD CONTROL AND OTHER PURPOSES
STORMWATER TREATMENT AREA 1 EAST
PSTA DEMONSTRATION PROJECT
CIVIL
CONCEPTUAL DESIGN ALTERNATIVE 1C
SITEPLAN

Scale: AS SHOWN

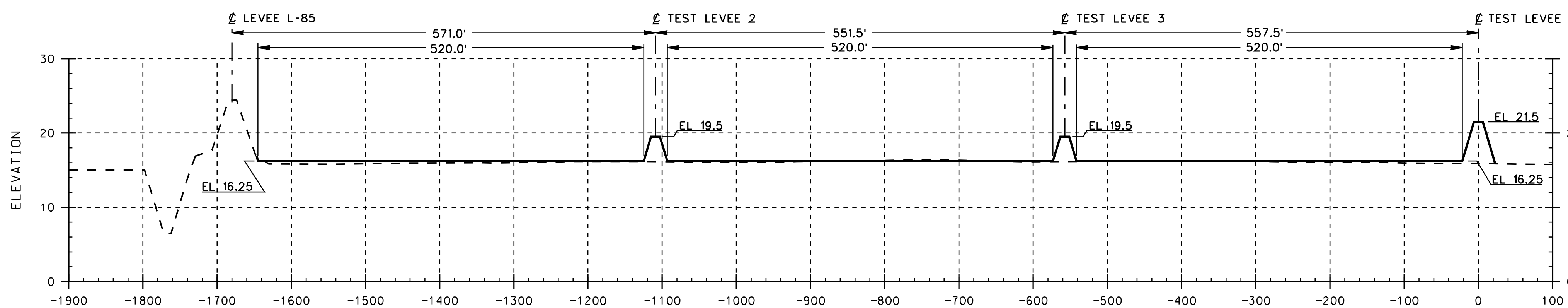
PLATE NO.
W 201



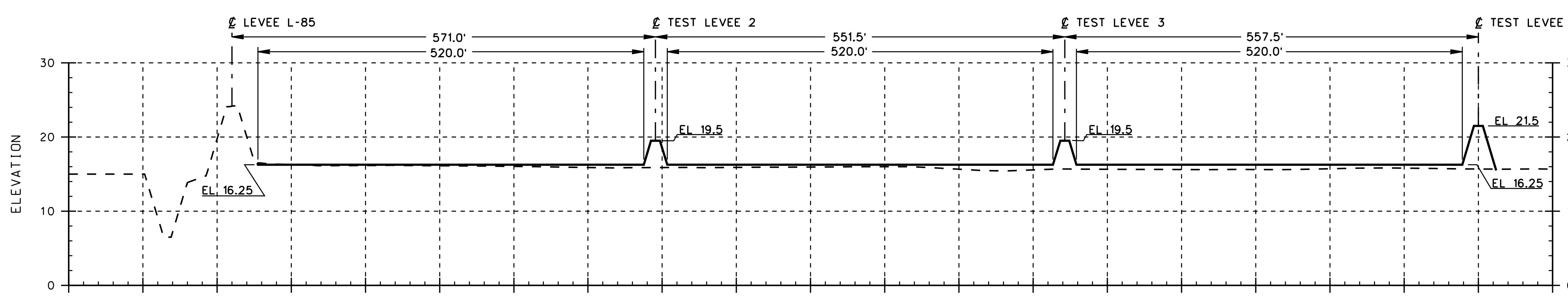
SECTION A - A



SECTION B - B



SECTION C - C



SECTION D - D

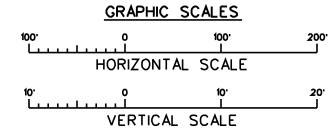
- - - - - EXISTING
——— PROPOSED

LEGEND

NOTES:

1. EXISTING GROUND FROM CHECK SURVEY 02-200 AND CONTRACT DACW17-02-B-0009 PLANS.
2. PROPOSED ELEVATIONS ARE FINISHED GRADES ONLY. SUBSTRATES NOT SHOWN FOR CLAIRTY.
3. CUT/FILL LINES NOT SHOWN FOR CLARITY.
4. ALL PROPOSED SIDE SLOPES ARE 3H:1V.

GRAPHIC SCALES



PRELIMINARY
NOT FOR CONSTRUCTION

US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

Designed by:
Dwn by:
Ckd by:

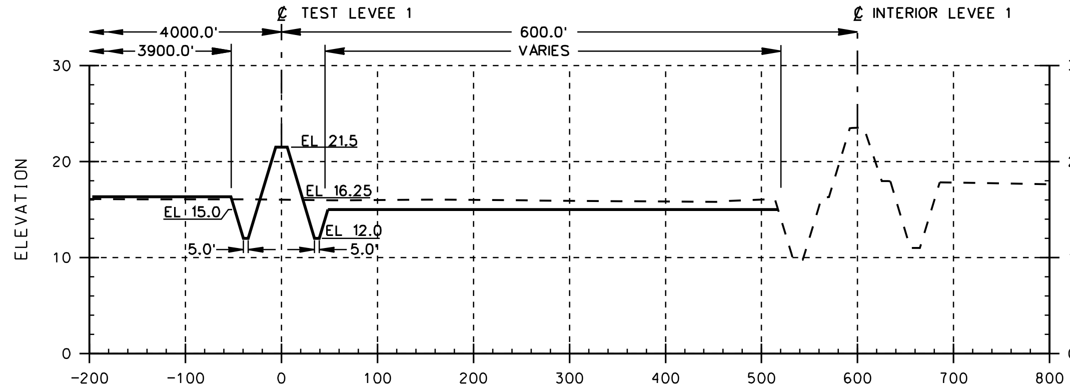
D.O.FILE NO. 400-38, 481
Dated: FEB 2005

File name: STAIE-PSTA_ALT1B.DGN
Reference files: STAIE-PSTA_BRDR_B.DGN

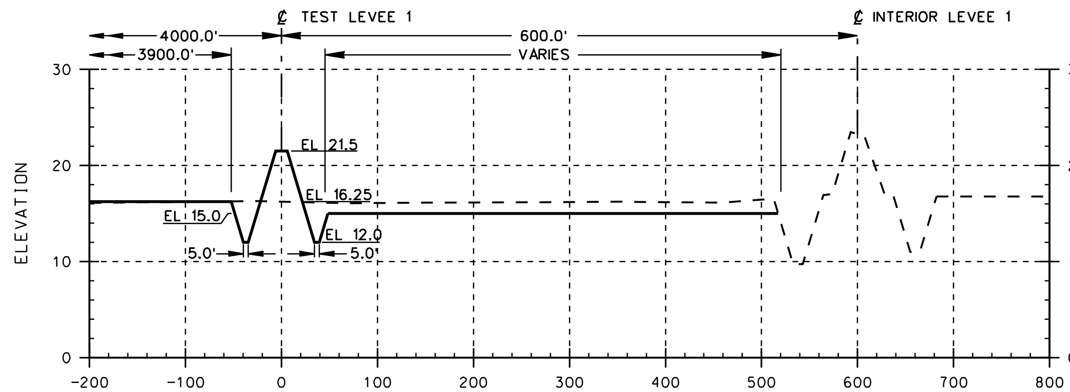
CENTRAL AND SOUTHERN FLORIDA PROJECTS
FOR FLOOD CONTROL AND OTHER PURPOSES
STORMWATER TREATMENT AREA 1 EAST
PSTA DEMONSTRATION PROJECT
CIVIL
CONCEPTUAL DESIGN ALTERNATIVE 1C
SAV & TEST CELL SECTIONS

Scale: AS SHOWN

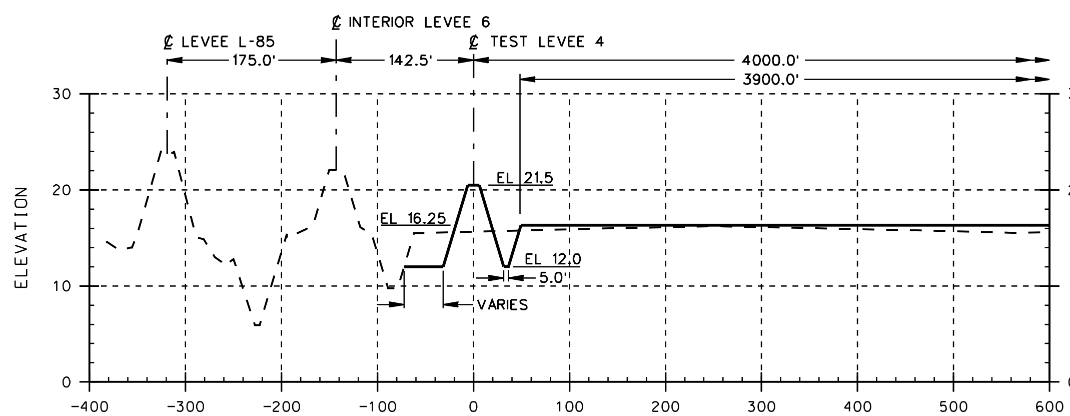
PLATE NO.
W 202



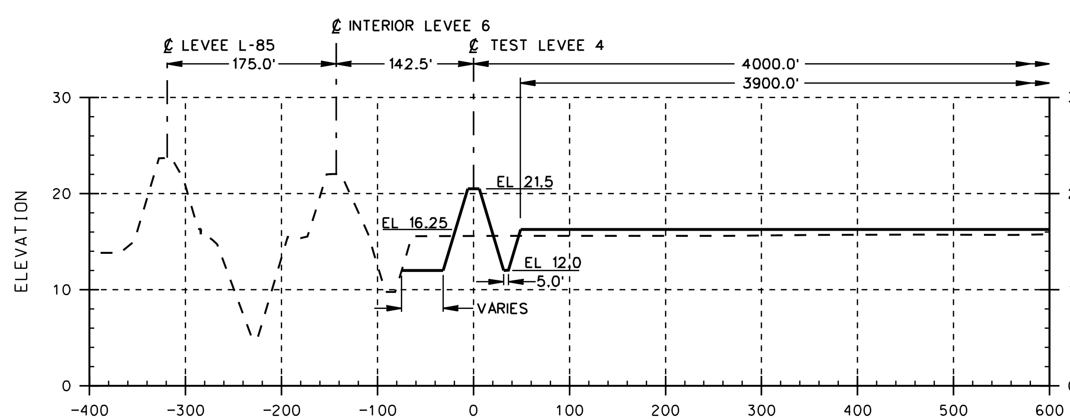
SECTION E – E



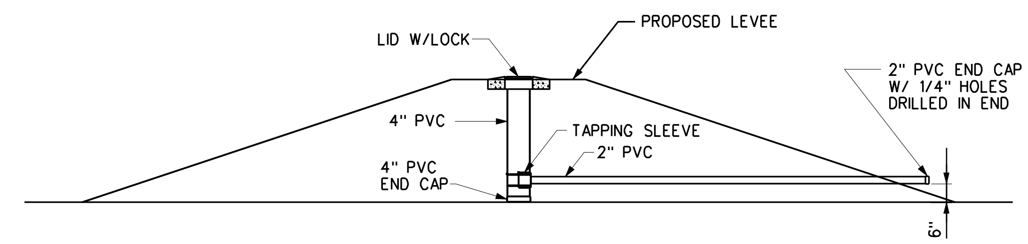
SECTION F – F



SECTION G – G

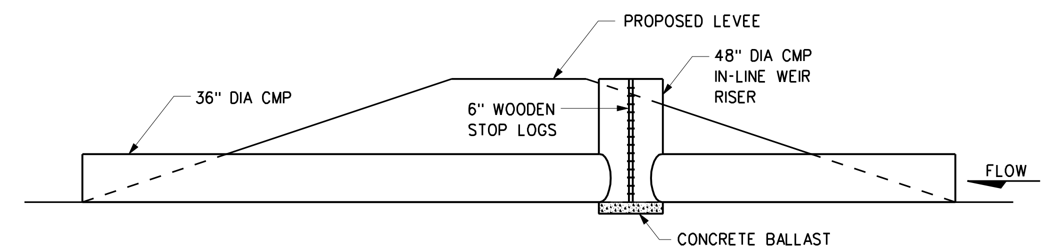


SECTION H – H



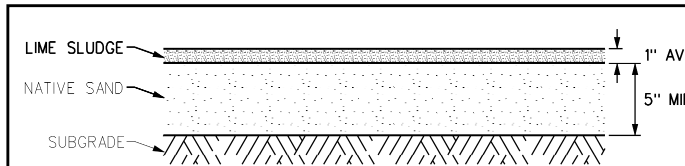
TYPICAL SECTION - PVC STILLING WELL

NOT TO SCALE



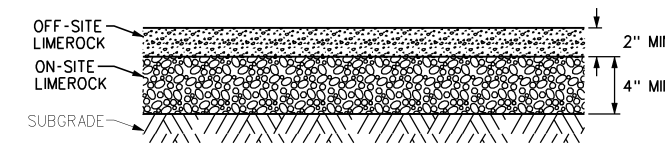
TYPICAL SECTION - IN LINE FLASHBOARD PIPE AND RISER

NOT TO SCALE



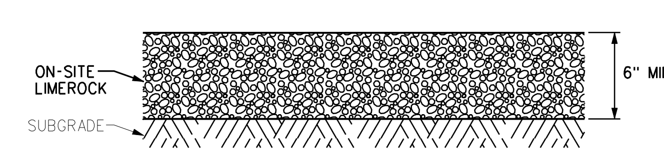
TYPICAL SUBSTRATE SECTION - TEST CELL 1

NOT TO SCALE



TYPICAL SUBSTRATE SECTION - TEST CELL 2

NOT TO SCALE



TYPICAL SUBSTRATE SECTION - TEST CELL 3

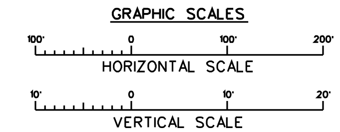
NOT TO SCALE

- - - - - EXISTING
——— PROPOSED

LEGEND

NOTES:

1. EXISTING GROUND FROM CHECK SURVEY 02-200 AND CONTRACT DACW17-02-B-0009 PLANS.
2. PROPOSED ELEVATIONS ARE FINISHED GRADES ONLY. SUBSTRATES NOT SHOWN FOR CLAIRTY.
3. CUT/FILL LINES NOT SHOWN FOR CLARITY.
4. ALL PROPOSED SIDE SLOPES ARE 3H:1V.



PRELIMINARY
NOT FOR CONSTRUCTION

US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

D.O.FILE NO. 400-38, 481
Dated: FEB 2005

Designed by:
Dwn by:
Ckd by:

File name: STA1E-PSTA_ALT1B.DGN
Reference files: STA1E-PSTA_BRDR_B.DGN

CENTRAL AND SOUTHERN FLORIDA PROJECTS
FOR FLOOD CONTROL AND OTHER PURPOSES
STORMWATER TREATMENT AREA 1 EAST
PSTA DEMONSTRATION PROJECT
CIVIL
CONCEPTUAL DESIGN ALTERNATIVE 1C
TEST LEVEES 1& 4 SECTIONS AND DETAILS

Scale: AS SHOWN

PLATE NO.
W 203